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[OFFICIAL NOTICE.]

Twenty-ninth Annual Meeting of the New England Association of Gas Engineers.

OFFICE OF THE SECRETARY, LYNN, MASS., Feb. 5, 1899.

The twenty-ninth annual meeting of the New England Association of Gas Engineers will be held at Young's Hotel, Boston, on Thursday and Friday, February 16 and 17, 1899.

The meeting will be called to order at 10 o'clock, A.M., Thursday, February 16, for the transaction of business, the reading and discussion of papers, and other matters of interest to be brought before the Association. An interesting list of papers and short topics is being arranged for, but it is impossible at this time to announce their titles and authors.

On Thursday evening the members will dine together, and on Friday the members are invited to inspect the works of the New England Gas and Coke Company, at Everett. This visit will take place after a short morning session, to allow those who wish to take the afternoon trains.

Blank applications for membership may be had of the Secretary. Applications for membership, and all other matters requiring the consideration of the Directors, should be sent to the Secretary before Wednesday, February 15. CHARLES F. PRICHARD, Secretary.

[OFFICIAL NOTICE.]

First Annual Meeting, The Kansas Gas, Water and Electric Light Association.

OFFICE OF THE SECRETARY, LEAVENWORTH, KAS., Jan. 27, 1899.

To the Members of the Kansas Gas, Water and Electric Light Association: The first regular meeting of this Association will be held in Topeka, Kas., on Wednesday, the 15th, and Thursday, the 16th of February. Members of our Association, and all who may desire to attend our meeting, will kindly govern themselves accordingly.

Yours truly, J. H. FOLEY, Secretary.

[OFFICIAL NOTICE.]

Sixth Annual Meeting, Michigan Gas Association.

OFFICE OF THE SECRETARY, SAGINAW, MICH., Jan. 31, 1899.

To the Members of the Michigan Gas Association: Gentlemen—The Sixth Annual Meeting of the Michigan Gas Association will be held in Lansing, on Wednesday, the 22d, and Thursday, the 23d, of February, next. The headquarters of the Association will be at the Hotel Downey, the rates at which hotel are from $2 to $4 per day. Papers for presentation will be:

"A Desirable Increase and its Source," by Mr. S. E. Wolf.

"The Importance of Proper Boiler Settings in Water Gas Plants," by Mr. John R. Lynn.

"How we Obtain our Patrons," by Mr. A. L. Zwisler.

Contributions will also be made by Mr. B. O. Tippy and Mr. T. B. Guitteau. Respectfully, HENRY H. HYDE, Secretary.

[OFFICIAL NOTICE.]

Fifteenth Annual Meeting, Ohio Gas Light Association.

OFFICE OF THE SECRETARY, DELAWARE, O., Feb. 6, 1899.

To the Members of the Ohio Gas Light Association: The 15th annual meeting of the Ohio Gas Light Association will be held at Springfield, O., March 15 and 16, 1899.

President B. P. Holmes, of Youngstown, O., will call the meeting to order Wednesday, March 15, at 10 A.M., in the Arcade Hotel, the headquarters. An address of welcome will be delivered by the Governor of Ohio, General Asa S. Bushnell, President of the Springfield Gas Company. The following papers are promised:

"Distribution Records: Their Uses and Preservation," by Mr. J. A. Mayer, Supt. of Streets, Detroit (Mich.) City Gas Company.

"Street Lighting," by Mr. J. W. R. Cline, Secretary and Manager, Springfield (O.) Gas Company.

"A Bunch of Short Topics," by Mr. Henry L. Doherty, General Manager, Madison (Wis.) Gas and Electric Company.

"Some Notes on the Construction of a Concrete Gasholder Tank," by Mr. C. W. Andrews, President Hamilton (O.) Gas Light and Coke Company.

"By-Product Coke Ovens," by Mr. E. E. Eysenbach, Supt. of Works, Columbus (O.) Gas Company.

The executive session will be unusually interesting, and some "Notes" on a subject of vital importance to the profession will be presented. The Question Box will be given special consideration, and each member is requested to make contributions for it.

An opportunity will be given any of the speakers at the meeting to correct their remarks before leaving Springfield; but not after, as all the reports will be turned over to the printers immediately after the adjournment of the meeting.

The management of the Arcade have named the following very low rates for the meeting: $2, $2.50, and $3 per day, American plan. The most satisfactory quarters are always obtained by writing in advance to the hotel people.

Application blanks for membership, and any further information which may be desired relative to the meeting, will be furnished with pleasure by the Secretary. T. C. JONES, Secy.

[OFFICIAL NOTICE.]

Wrinkle Department, Western Gas Association.

WESTERN GAS ASSOCIATION, OFFICE OF THE SECRETARY,
NEW ALBANY, IND., Jan. 16, 1899.

To the Members of the Western Gas Association:

Mr. E. H. Jenkins, Editor of the Wrinkle Department, desires it known that those who have contributions to offer for publication in this valuable division of the Association's proceedings, should forward the same at as early a date as possible. All matter of this nature should be in hand not later than April 1st. Let no member fail to mail Mr. Jenkins a description of any device that saves labor or insures through its use better service in the production or distribution of gas.

Address all communications to Mr. E. H. Jenkins, Engineer Buffalo City Gas Company, Buffalo, N. Y. J. W. DUNBAR, Secretary.

BRIEFLY TOLD.

PROGRESS IN RESPECT OF THE EDUCATIONAL WORK BY THE AMERICAN GAS LIGHT ASSOCIATION.—Much practical progress has been made towards properly carrying out the educational engineering work undertaken by the American Gas Light Association, for which work, at our time of last writing over the matter (Nov. 28, 1898), a subscription fund, amounting to $3,598 per annum for the 5-year period had been pledged. Some days ago, the Trustees of the Gas Educational Fund (Messrs. Eugene Vanderpool, Newark, N. J.; Walton Clark, Phila.; W. F. Douthirt, N. Y.; Jos. B. Crockett, San Francisco; and A. C. Humphreys, N. Y.), or a majority thereof, held a meeting and perfected the following organization: Chairman, Walton Clark; Treasurer, Eugene Vanderpool; Secretary, A. E. Forstall; Finance Committee, W. F. Douthirt and A. C. Humphreys. Following the organization suitable offices were engaged in the premises, No. 58 William street, New York, one room of the suite to be devoted to the use of the American Gas Light Association, as a headquarters for its members when they see fit to avail themselves of its opportunities. The Trustees propose in time to accumulate at headquarters a library and so on. At present the educational class numbers on its students' roll no less than 100 names, and we are informed that many other names are on the waiting list, such waiting being solely caused by the inability of the Trustees to provide for the wants of the waiting ones, because of the limitation arising from the lack of funds. The Trustees are preparing a circular which is to set forth clearly what has been done and that which it is proposed to further accomplish on the lines of their labors. The amount pledged now totals at $3,798 per annum over the 5-year period—presuming that our last mention of the fund had not shown an increase from any other source—the increase being accounted for by a generous lump subscription to the fund, by the Consolidated Gas Company of this city, of $1,000.

NOTES.—Mr. Louis des Cognets has been elected President of the Lexington (Ky.) Gas Company.——The proprietors of the Gloucester (N. J.) Gas Company propose to reduce the gas rate. It would stand a shaving.——At the annual meeting of the Washington (D. C.) Gas Company the following Directors were elected: Jno. R. McLean, Jno. C. Bullitt, James W. Orme, Geo. T. Dunlop and Jno. F. Rodgers.——At the annual meeting of the shareholders in the New Britain (Conn.) Gas Light Company the officers chosen were: Directors, Jas. H. Eddy, F. N. Stanley, A. J. Sloper, H. E. Russell and E. N. Stanley; President, Jas. H. Eddy; Secretary and Treasurer, A. J. Sloper.

Domestic Coke and Briquettes from Retort Coke Ovens.

[A paper read by MR. R. M. ATWATER, at the last meeting of the Ohio Institute of Mining Engineers.]

Four years ago, by the kindness of your Secretary, Mr. Hazeltine, I offered to your attention the operation of the retort coke oven. In the interesting discussion that followed this paper, the possibility of using Ohio coals for blast furnace coke was considered as being a desirable result for the large interests which you represent. I regret to say that but little progress has been made in the practical solution of this important question. Ohio coals are not used to-day to any extent in either retort or beehive coke ovens.

Still the question is not finally settled. The two difficulties to be overcome are the high content of sulphur, which injures the quality of the iron, and the high percentage of volatile matter in the coal, which results in a soft-bodied coke.

This same difficulty affects, to an even greater degree, the Illinois coals, and on account of the large requirements of coke in the Chicago blast furnaces efforts are constantly made to obtain blast furnace coke from these coals. A Chicago engineer claims to be able to eliminate the sulphur from the coke while at a red heat in the coke oven by blowing through it a jet of superheated steam and acetic acid. Even if this result should be accomplished, I doubt if it could be done economically. A well known Pennsylvania engineer has tried to accomplish it by grinding the coal fine and floating it through a pipe line from the mines to the great consuming centers of the middle West. He has demonstrated that coal with an equal weight of water can be transported for hundreds of miles, turning corners, ascending and descending grades, at a lower cost than by rail.

It was expected that one result of the fine grinding would be the reduction of the sulphur, but, while there was some reduction, it was not enough to make a coal having 3 or 4 per cent. of sulphur suitable for making blast furnace coke, which should be not over 1 per cent.

But this fine grinding has advanced the solution of the problem, and may yet solve it. It has been found that when coal is ground to pass through a 3-32 mesh, the pyritic sulphur and the float sulphur are both separable to a large extent. So, by means of a riffle or jig washer, the heavy pyrites are separated. Then by allowing the overflow of the riffles carrying the good coal and the float sulphur to pass into heavy settling tanks the float sulphur is carried off in the overflow, and coals carrying 3 to 4 per cent. of sulphur are reduced to less than 1 per cent., and so are brought into the blast furnace class of coking coals.

This process is, I believe, original with Mr. C. C. Upham, of New York, and while, so far as I know, has not been put in practice on a commercial scale, yet it seems to me to have strong elements in its favor. This is a research which might engage the attention of the technical department of your university. The resulting coal in the form of fine slack, reduced by draining so as to contain not over 10 per cent. of moisture, is in the most favorable form for use in the retort coke oven. The operation of the oven still further reduces the amount of sulphur so that the sulphur present in a ton of retort coke is rarely greater than in a ton of the coal charged.

Regarding the second difficulty with Ohio coals, viz., the high percentage of volatile matter which makes a soft and spongy coke. A good many tests have been made at Syracuse on such coals, and it has been satisfactorily shown that these coals make a denser and stronger coke in the retort oven than in the beehive oven. Further, by mixing these coals with a small proportion of coals from other localities, such as Pocahontas, or northern Pennsylvania, which naturally makes a hard coke, this difficulty with the Ohio coals may be overcome.

I therefore believe that the problem of making the Ohio coals useful for the highest grade of coke is capable of solution, and, with the large increase of iron making in Ohio, it may well engage your interest.

During the last four years retort oven plants have been put in at Dunbar, near Connellsville, Pa., Sharon, Pa., Wheeling, W. Va., and Birmingham, Ala. All these plants make coke for blast furnaces, and the results from each are satisfactory, both technically and financially. The Dunbar furnace, before the retort ovens were started, used exclusively beehive coke from Connellsville coal. This has given a good basis for comparison with the best beehive coke in the country. The Dunbar furnace has surpassed all previous records while using exclusively retort coke, and the owners and manager have given their opinion that the retort coke is better than standard Connellsville beehive coke. All these plants are likely to be enlarged to meet the increased requirements of the furnaces.

The plant at Syracuse, New York, has already been doubled in size,

and has for the last year been supplying foundry coke of a high grade to all the principal iron foundries in the neighborhood of Syracuse.

A plant of retort ovens was built last year at Halifax, N. S., using Dominion coal. Since last June this plant has supplied the illuminating gas used by the city of Halifax. This plant has, by a special adaptation of the gas mains, been able to deliver an unenriched gas of 18-candle power directly into the holders of the Halifax Gas Company. This is perhaps the most important improvement to record in the development of the American retort coke oven.

There is also a large plant of retort ovens near McKeesport, Pa., running entirely on domestic coke, and a plant under construction at Boston, Mass., which will also make domestic coke.

Domestic coke is also being produced at many beehive oven plants and has been on the market for several years, competing with anthracite coal as a domestic fuel. The coke produced by illuminating gas plants has always been to some extent used for domestic fuel, but the form and character differ so materially from the crushed oven coke that it can hardly be said to have been a serious competitor. The rapid increase in water gas plants has also tended to decrease the supply of this form of domestic fuel.

This leads to the main purpose of my paper, viz., the use of Ohio coals in their present condition for making domestic coke and briquettes in the retort oven, as a practical operation for the coal operators of Ohio.

For the ordinary use of the household, either lump bituminous coal or anthracite is in general use, while slack coal is not used to any extent. Anthracite is used, I suppose, to a limited extent in the southern part of the State, but in the northern tier of cities is in general use, its freedom from smoke and gas making it more desirable and always preferred when the increased cost is not too great.

Crushed coke differs from lump bituminous coal in carrying no gas or smoke. In this respect it closely resembles anthracite, but on account of its porous character it burns more like bituminous than anthracite. Anthracite burns only on the surface, or until the lump after becoming red-hot falls to ashes or melts to clinker. Coke, when it becomes hot enough to burn, burns throughout its whole bulk, and from a glowing mass falls quickly to ashes. On this account it occasions some trouble in managing the fire, which goes out quickly when it is not supplied with a fresh supply at a time when anthracite coal would last much longer. Also, on account of its greater bulk, it occupies more room in the stove for a smaller actual amount of fuel.

Fuel briquettes have not been used to any extent in this country, but they have some advantages over any other domestic fuel. They are made in enormous quantities, estimated at 10,000,000 tons, in all the chief coal producing countries of Europe, and have won a permanent place in the great markets of the world. Not only are they in common use as a domestic fuel, but the locomotives and steamships of Europe use them very largely. They are made of different sizes, corresponding to the market sizes of anthracite coal, for boilers, locomotives, furnaces, grates and stoves. By their use the waste coal, both bituminous and anthracite, at the mines and in the great coal depots in the cities, is completely utilized. If such a use can be made of the great slack heaps in the Ohio mines, it will be of far-reaching benefit to the miner and the household.

If briquettes are made of bituminous slack, they have the nature of bituminous lump coal, but on account of their density, being pressed as bricks at a great pressure, there is much less waste in dust, and slower and more economical combustion. But they can be made of anthracite slack as well as from bituminous slack, or from coke breeze, and in this form they have all the advantages of anthracite coal.

The retort coke oven affords the means of utilizing Ohio coal in either or all of these three forms, viz., crushed coke, soft or smoky briquittes, and hard or smokeless briquettes, and it allows either or all of these forms of domestic fuel to be produced at a cost which will yield a good profit at the selling prices of their corresponding grades of fuel now in use.

To make this clear, I will give you the details of the operation of a block of retort ovens, on a practical scale and of a size best suited to economical operation. It will be quite practical to make an operation on a much smaller scale, but an operation to produce 100 tons of coke and 100 tons of briquettes a day is a convenient unit to present for your approval and criticism.

The plant will consist of 18 retort coke ovens with all the apparatus for recovering the by-products, ammonia, tar and gas. Also a tar distilling plant for converting the tar into oil and pitch for briquetting; also a briquetting plant for making 100 tons of briquettes in 10 hours. The plant will occupy less than an acre of ground, and will cost, exclusive of land and a water supply and railroad connections, from $100,000 to $125,000.

Such a plant can be operated in three ways, according to the amount and quantity of the product desired.

First, let us consider its operation to produce, as I have said, 100 tons of briquettes per day on Ohio coking coal.

Each oven will take 8 tons of coal and coke it in 24 hours, or 144 tons per day, and 52,000 tons per year.

The coal will yield 70 per cent. of domestic coke, or 100 tons of coke per day, or 30,000 tons per year.

The operation and maintenance in good repair of the plant will cost 40 cents per ton of coke, or $14,400 per year.

There will be recovered from the volatile part of the coal in the by-product apparatus 520 tons of ammonia, reckoned as sulphate, per year, which has an assured market value of $15,600, or amply sufficient to cover the entire cost of operating the ovens and by-product works.

There will also be recovered from the oven gas 2,600 tons of tar, which has a market value of $4 per ton, or $10,400 per year.

After supplying all the heat required for coking the coal and raising steam for all the power required by the ovens and by-product works, there will be left a surplus of 3,000 cubic feet of gas per ton of coal, or 156,000,000 cubic feet of gas, which is worth for manufacturing purposes 5 cents per 1,000 cubic feet, or $7,800 per year.

The low value given this gas does not represent its true value, but its actual fuel value in replacing coal and reducing it is still lower because it is produced at all hours of the day and all days in the year, and no provision is made for storing it in a holder. The gas carries about 600 heat units per cubic foot, and is, for many purposes, equal in efficiency with natural gas.

It is practically the same as unenriched illuminating gas. If local gas companies will, as is done in Halifax during the past year, take the gas for their use, it can be enriched by the luminous portions of the fuel gas, and can be delivered of 18-candle power. It would, of course, in this case be worth double the amount here estimated for it, and the holders of the illuminating gas company would be available for storing it. Still, at the figure above given, the value of $7,800 per year is sufficient to pay the interest on the investment of money for the whole plant.

The operation thus far stands as follows:

The ammonia recovered will cover the cost of operating the ovens and by-product works, while the surplus gas will pay the interest on the investment. I do not state the cost of coal for that is a local matter. I also consider that any operation likely to be undertaken will be in the interest of coal operators. The value of the tar stands as a clear profit, and a ton of crushed coke costs only the coal required to make it. As it takes 1.4 tons of coal to make 1 ton of coke, if coal costs at the ovens $1 per ton, the cost of 1 ton of crushed coke is $1.40. If coal costs 50 cents per ton, a ton of coke costs 70 cents, and the $10,000 worth of tar is a profit or asset beyond this cost of the coke. At the price of anthracite coal in the Columbus market to-day, the operation seems attractive.

Taking up the second part of the operation—the making of briquettes—we will consider that the tar will have to be distilled. The cost of the distilling plant, about $5,000, I have included in the total of $125,000 for the whole plant, also the cost of the briquetting plant, $20,000.

The distillation of the tar is a very simple operation, and the oils produced have sufficient value to pay for the cost of the distillation. We may therefore consider the 2,600 tons of tar as equal to 1,800 tons of pitch, which is the material used for cementing or binding the briquettes. If pitch alone is used for the bind, it takes 8 per cent. of the coal. If lime is used with the pitch, 5 per cent.; 1,800 tons of pitch will therefore supply the bind for 36,000 tons of briquettes per year, or 100 tons per day.

The cost of operating the briquetting plant on the basis of 100 tons a day for 10 hours, is given me by parties claiming to be familiar with the business, as 25 to 30 cents per ton of finished product. As 100 tons of coal will make 108 tons of briquettes, we may say that 50 cents per ton of briquettes is a sufficient figure for the cost of manufacture, not counting the value of the pitch, which is a clear profit from the coking part of the operation.

We, therefore, have 100 tons of briquettes which cost what 100 tons of slack coal cost, plus 50 cents per ton. If the coal costs $1 per ton, the briquette costs $1.50 per ton, and will sell in competition with lump coal and be preferred on account of their uniformity in size and cleaner condition.

Summing up the whole operation briefly, we have, after paying all operating expenses and interest on the investment, 100 tons of crushed coke, costing the value of 140 tons of slack coal, and 100 tons of soft coal briquettes, costing the value of 100 tons of slack coal, plus 50 cents per ton. The value of the coal at any point where the plant may be located, can be supplied and also the competing value of anthracite against the crushed coke or of lump coal against the briquettes.

Two other methods of operation are, however, worth our consideration. As I said before, briquettes may be either made from soft coal, and consequently smoky, or from anthracite slack, in which case they will be smokeless and in every way equal to anthracite.

For this purpose the coke may be ground to a fine powder and the pitch used to make smokeless briquettes, which should command the full price of anthracite coal. On this basis the operation will stand as follows: 108 tons of smokeless briquettes will cost the value of 140 tons of bituminous slack coal, plus 50 cents per ton. If this slack costs $1 per ton, the cost of these briquettes will be $1.90 per ton. If the coal costs 50 cents per ton, the briquettes will cost $1.20 per ton.

The other method of operation is of interest in view of the large quantities of non-coking coal in the Hocking Valley region. This slack coal is considered of no value at the mines, and its cost at any operating plant is simply its freight. This coal can be charged into the coke ovens and all the volatile matter distilled off and the tar, ammonia and gas recovered precisely as is the case with coking coal. The resulting carbon will be drawn from the oven, quenched, and passed through rollers to make it of suitable firmness, and made into smokeless briquettes, which will compete with anthracite coal. The cost will be the same as briquettes from the crushed coke, but the coal may be of lower cost, and so the operation will yield a greater profit.

These three forms of operation may be carried on in the same plant either simultaneously or at different times, according to the conditions of the market for the several products. In general it may be said that coal is the cheapest form in which the various products, tar, ammonia, gas, coke and briquettes can be transported, as the f. o. b. rates on coal are on the lowest basis of all commodities. Therefore, in selecting a case for the operation, the preference should be given to that place affording the best market for all the products. The consumption of anthracite coal at the place for the operation is also an important element, as it is easier to displace an article in common use than to create a market for a superior article.

Coal-Handling Machinery.

[A paper read by MR. CHARLES PIEZ, before the Engineers' Club, Phila.]

The total coal production of the United States during the year 1896 was 190,500,000 net tons. Assuming that on an average each ton is handled three times from the mines to the place of combustion, we have the eqivalent of 571,500,000 tons handled each year. A large percentage of this coal is still handled by primitive methods, and in spite of the economy effected by coal-handling machinery already introduced, it is certain that 10 cents per ton would be a conservative average cost for each handling. The handling of coal in the United States represents therefore an annual expenditure of approximately $60,000,000, and the province of coal-handling machinery is to reduce this vast expenditure to a minimum.

The problem of handling coal, as it is ordinarily presented to the manufacturer of this class of machinery, consists in elevating or conveying it, or both, either in its preparation at the mines; its storage between the mines and the market; its storage at retail yards; and its handling at points of consumption. In each case the solution depends upon the distances through which it is to be transferred, the rate of handling to be attained, the size of coal to be handled, the length of service required, and the conditions under which the machinery is to be operated.

Coal-handling machinery can be divided into two general classes, the continuous and the non-continuous. To the former belong the chain and belt elevators, and conveyors as ordinarily manufactured; to the latter belong the various types of automatic and tub hoists, the overhead bucket tramways, and the cable railways. Each class has its own field of usefulness, and proves highly efficient only so long as it is confined within its proper sphere. Generally speaking, continuous machinery is more efficient than non-continuous, because it has greater capacity, is composed of lighter and smaller units, and requires therefore less power to accomplish its work. This paper will confine itself to a brief discussion of continuous coal handling machinery, under the two heads of elevators and conveyors.

Fig. 1.—Centrifugal.

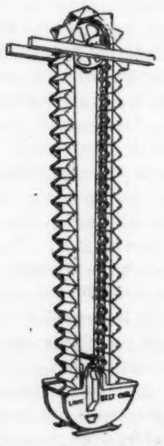


Fig. 2.—Continuous Bucket.

We distinguish as elevators those machines which are specifically employed for lifting vertically, while we distinguish as conveyors those machines which are more especially employed for moving material horizontally. Both classes are often used for carrying material on an incline, so that it is possible to have either an elevator or conveyor at 45°.

In elevating coal—more especially anthracite—care should be taken to handle it gently, so as to avoid breakage. This breakage is likely to occur either at the point of feed, or at the point of delivery. In the common form of elevator, known as the centrifugal discharge elevator, neither of these points is given attention. This elevator consists of either a single strand of chain, or a belt with buckets at intervals, and depends upon the centrifugal force attained by high speed around the head wheel for its discharge. The material is scooped up in the elevator boot by buckets ploughing through it at a high rate of speed, and when delivered is forcibly thrown against the bottom of the receiving chute, causing very considerable breakage at each end.

Fig. 3.—Perfect Discharge.

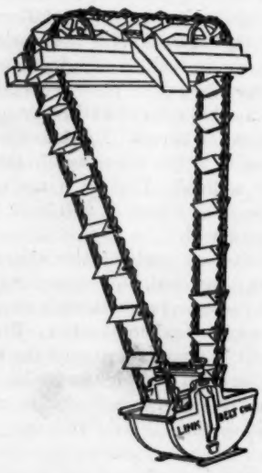


Fig. 4.—Gravity Discharge.

For the steam sizes of anthracite and for bituminous slack, this treatment can be endured, but when it is remembered that each 1 per cent. of breakage in the domestic sizes of anthracite coal means a loss of from 4 to 5 cents per ton, it becomes evident that an elevator of crude construction can cause more loss from breakage than it saves in the handling. The speed of elevators of this type averages, for coal, about 240 feet per minute, with a 30 inch head wheel, and as the speed is the chief cause of breakage, both in the boot and at the point of discharge, a satisfactory elevator must discharge at a low speed, or without reliance upon centrifugal action. Three forms of elevator meet this requirement. The first is the continuous bucket elevator, and consists of a single strand of chain or belt with buckets attached continuously.

The buckets are of such a shape and so placed that the front of each bucket when inverted acts to complete the permanent chute in receiving the discharge of the material from the bucket following it. This manner of discharge still permits a slight drop of the coal, but it is a vast improvement over the discharge of the centrifugal type. The action in the boot, owing to the materially slower speed, is also kinder, and the breakage, in consequence, is materially less. The continuous

Fig. 5.—Link-Belt Carrier.

bucket form of elevator, while it does not form an ideal machine for the domestic sizes of anthracite, is a compact rugged machine of great carrying capacity, and is for this reason largely employed in the anthracite region. For the steam sizes it is unexcelled as an elevator.

The second form of slow speed elevator is known as the perfect discharge type, and consists of two strands of chains with the buckets hung centrally between them. Deflecting wheels placed immediately under the head wheels, force the buckets away from the line of the discharge, and allow the receiving chute to be extended to such a point that it will catch the material when it drops from the discharging bucket. The form of discharge entails a very considerable drop, and makes the elevator inapplicable where minimum breakage is the object sought after. This elevator has a wide use for materials of a sluggish nature, as the complete inversion of the bucket makes a clean discharge possible.

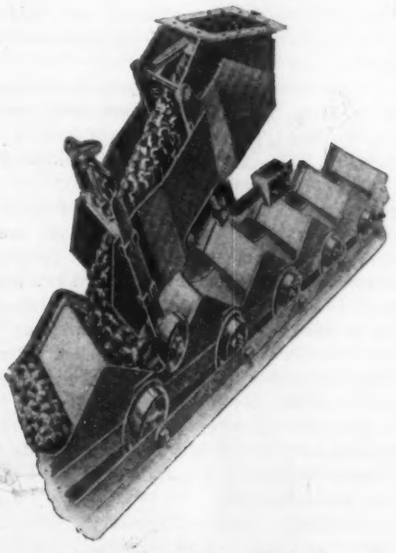


Fig. 6.—Link Belt Automatic Chute.

The third form of slow speed elevator is known as the gravity discharge, and consists of buckets of a broad V-shaped cross section, hung centrally between two strands of chain. The buckets after passing around the head wheel are carried horizontally for a short distance, a trough being introduced under the buckets, so as to retain the coal as it flows from the partly inverted buckets. The trough is carried parallel with the line of buckets for some distance, and is then merged into the discharge chute by a gentle slope, the coal being carried along the trough to the point of discharge by the buckets, which act as scrapers. The discharge is effected by flowing, instead of by dropping or throwing, and the most gentle treatment of the coal that is possible is insured. This elevator is the most perfect of the three types of slow speed elevators described, and is largely employed in the handling of domestic sizes of coal.

In all of the above elevators the feeding is done by means of a boot, and the safety of the machine depends upon a proper regulation of the feed. To insure this, a regulating gate is necessary, and as these gates as commonly made are not automatic, a man is required to operate them. Feeding through a boot, even at slow speeds, is always accompanied by some breakage due to the dredging of the buckets through the material, and this dredging action is wasteful of power and often dangerous to the integrity of the machine.

To overcome these objections, and at the same time to construct a machine which would render a simple automatic feed feasible, there was developed about a year ago a form of elevator known as the "link-belt carrier elevator." This elevator consists of a series of overlapping buckets resembling a series of open-top boxes set at such angles with the two lines of operating chains that they will carry on two sides of a rectangular path. The lower end of the carrier elevator is extended into a horizontal loop into which the material is fed by an automatic chute. Material can be fed into either the upper or under run of this loop, as best suits the conditions to be met. In the former case the discharge is effected around the outside of the head wheels as in the case of the continuous bucket elevators. In the latter case the discharge takes place on the inside of the head wheels, after the manner of the gravity discharge elevators.

A carrier elevator, with inside discharge, was put into operation about two weeks ago, in connection with a 3,000-ton locomotive coaling station, erected for the Erie Railroad Company at Jersey City. The horizontal loop of the elevator extends under two feeding tracks, and coal is delivered into the elevator from two dumping hoppers located on these tracks, the flow being controlled by two automatic chutes. The elevator handles three kinds of coal; lump anthracite, an aggregation of lumps varying from 10 to 30 inches in length, rice and birdseye anthracite and run-of-mine bituminous. Lump anthracite requires an opening 42 inches wide and 26 inches high for a free discharge, and through such an opening the coal, if unchecked, would flow at the rate of from 12 to 15 tons per minute—fully four times the capacity of the elevator. The satisfactory operation of the machine depends, therefore, on preserving an opening which will permit of a free passage of the coal, and providing such means of checking it that the rate of delivery will not exceed the capacity of the elevator. This the automatic chute accomplishes to a nicety; in fact, so perfect is the control under which it holds the delivery of the coal to the elevator that the two chutes are utilized for another and very important function. The smaller sizes of anthracite, rice and birdseye, the latter of which is only one remove from dust, have a very limited market compared to their production, and form, therefore, the cheapest anthracite fuel. In order to render them available for locomotives, they are mixed with a small proportion of bituminous coal, which forms a binder and keeps the anthracite on the grates. The Erie Railroad Company uses this mixture very largely in the proportion of two parts of anthracite to one of bituminous, and this combination is coming into use with other anthracite burning roads. This mixture, if it can be readily and cheaply effected, forms the cheapest fuel known.

The mixing, in the coaling station referred to, is accomplished by dumping the two kinds of coal simultaneously into the two track hoppers, and adjusting the automatic chutes (but one chute shown in illustration) so that one will fill the buckets two-thirds full with anthracite, and the second will supply the other third of bituminous. In discharging from the elevator into the distributing conveyor the charge of each bucket is overturned, and this is again done when delivering into the bins. The result is thorough mixture, and pronounced highly satisfactory by the firemen.

In all elevators the weight of the machinery, as well as the weight of the material, is carried directly by the chain, and for large capacities and high lifts this weight assumes very large proportions. It is absolutely essential, to insure durability, that sufficient bearing surface be provided to reduce the pressure per square inch to an amount which will preclude cutting and gouging. A chain with a working strain of 6,000 pounds should have twice the bearing and sprocket surface of one having a working strain of 3,000 pounds. This is axiomatic, yet it is rarely given any consideration by the purchaser. He compares chains only by the tabulated working strain and rarely pays any attention to the area of sprocket and bearing surface, or the character of materials constituting the chain journals.

A very glaring case of the disregard of this fundamental truth of chain design came to my notice some weeks ago. A new sugar refin-

ery in the vicinity of New York had a problem of receiving coal from cars, lifting it 90 feet, and distributing it into an overhead bin 50 feet long. This would strike even a layman as a problem of elevating and not one of conveying, yet it was solved by the use of a pivoted bucket conveyor which, while a very excellent machine as a conveyor, was sadly out of place as an elevator. The weight of the machine and coal was roughly 100 pounds per running foot. On horizontal runs, machines of this type require about 5 per cent. of the total weight to move them, so that the strain for the lower horizontal run which augmented the strain at the head wheel, was about 250 pounds. The strain due to the vertical lift was 9,000 pounds, making a total of 9,250 pounds. The total bearing surface provided was that given by four straps $\frac{5}{16}$-inch thick, articulating on a 1-inch pin, or 1¼ square inches of projected area. This gives a unit bearing strain of over 7,400 pounds, which is far too high to ensure even reasonable durability. The criticism made is not against the machine, for under certain conditions it is a highly satisfactory conveyor, but it is against its use as an elevator of this height, for which its construction is entirely unsuited.

The problem of conveying coal is one that often presents itself with the problem of elevating; and the tendency in recent years has been to construct machines which will perform the double function. This tendency grew out of the desire to avoid transfers with the accompanying breakage and danger of accident, to save power and simplify its application.

The first solution presented was that employing a series of buckets suspended pivotally from two strands of chains. As the entire weight of machinery and load is thereby thrown on the chains these are fitted at the points of articulation with flanged rollers. The buckets are suspended from points a little above their centers of gravity when loaded, so that they will remain right side up, no matter in what direction they travel. They discharge by upsetting against suitably placed tipping blocks, which can be shifted at will. In order to reduce the shock of the blow, the point of suspension must be placed as low as possible, rendering them slightly unstable and necessitating slow speeds to prevent them from upsetting when rounding curves. This potential instability, as it might be called, renders careful loading necessary, and it is here that the great weakness of this machine exists. The small sizes of coal run freely through small openings and can therefore readily be controlled by throttling the orifice. But the larger sizes require openings, which if unchecked, would swamp the conveyor.

In some experiments made by the Link Belt Engineering Company several years ago, on the flow of coal through discharge openings in hoppers, it was found that egg coal required, under a head of 5 feet, an opening 18 inches square, to flow without choking, and that through

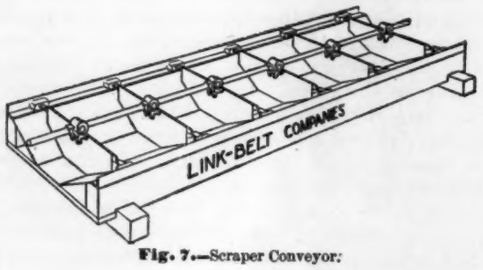


Fig. 7.—Scraper Conveyor.

this opening it discharged at the rate of 5 tons per minute. Even a slight reduction in the area of the opening resulted in the bridging of coal across it, and in a total stoppage of the flow. As the buckets in this form of conveyor swing freely on pivots, great care must be exercised in loading them centrally and uniformly to prevent harmful oscillation, and any one-sided load or overload is apt to result in a premature discharge. Very ingenious methods of filling the buckets have been devised, the most usual consisting of a short conveyor encompassing the delivery chute and consisting of a series of rectangular funnels of such shape that they will bridge the gaps between the conveyor buckets and place a very much constricted opening centrally over the bucket to insure proper loading. For handling large anthracite or bituminous coal the filling device fails in two respects:

1. It greatly reduces the discharge opening into the bucket and is of such a shape as to invite bridging across this opening.

2. It is in no way instrumental in checking the flow of the coal and preventing an overload.

The overlapping pivoted bucket, while it has the advantage of preventing leakage between buckets, and can, therefore, be loaded without the intervention of a filler when small coal is handled, shares the disadvantages of the older type in the handling of the large sizes.

The problem of providing a method of feeding bucket conveyors, which would dispense with the man at the feeding gate, and would at the same time insure a uniform delivery, engaged attention for some time about three years ago, and resulted in the development of the "link belt automatic chute," and its corollary, the rigid bucket carrier. The carrier is called a corollary of the automatic chute, because upon determining what seemed to us the only satisfactory form of chute, we found it could be operated only in connection with a rigid bucket conveyor. The chute consists briefly of an upper part, which is adjustable as to pitch, so as to suit the varying degrees of mobility of the material to be handled, and a lower hinged end operated by the cam-shaped sides of the buckets. The underlying principle of the chute is the presentation of an area of orifice which will insure a free delivery, the regulation of flow being accomplished by bending up the stream, after it has passed through the orifice. The limit of its capacity as a regulating device has already been referred to under the head of the carrier elevator.

The rigid, or, as it is styled, the link belt carrier, can be briefly described as a series of overlapping buckets rigidly connected to two strands of roller chain. The buckets are fitted with hoods, partially closing the tops, and of such shape that they will carry on three sides of a vertical rectangle. They are discharged by passing around a dumping carriage, which completely inverts the bucket. The carriage is movable at will, in either direction, by power, and affords a very easy method of changing the point of discharge.

For a carrier having a capacity of 70 tons per hour, the discharging carriage takes up 6 feet in height, by 3 feet in width, and this is sometimes urged as an objection to the machine, because space is an object. The discharging carriage is necessary in a rigid bucket machine, just as it is in a belt conveyor, and when space is an object, it is simply a question whether it is worth more than the man at the delivery chute. The carrier has another interesting feature, and that is the self-oiling roller. With the large number of rollers employed in a machine of this type, it is essential, to even reasonable durability, to provide some effective means of getting oil into the journals. This is accomplished in the link-belt carrier by using rollers having chambered cores connected by oil slots with curved hollow fingers adapted to pick up oil from a narrow tank located in the path of the fingers. This method of oiling flushes the journals and lubricates the joints of the chain as well. This is accomplished automatically, and the only labor involved consists in filling the oil tanks whenever oiling is necessary, and occasionally inspecting the oilers to prevent clogging.

The various forms of bucket machines just described are combination machines, and are rarely used for direct horizontal transfers.

There are four distinct types which are used for this purpose, viz.: 1. Screw conveyors. 2. Scraper conveyors. 3. Belt conveyors. 4. Continuous rigid bucket or pan conveyors.

Screw conveyors are so well known that they require no description. They occupy very little space, and on this account are often used for short conveyors handling small coal. They are perhaps the least expensive of the various forms of conveyors, but have a number of serious disadvantages which render them unfit for consideration except where small quantities of fine sizes of coal are to be handled. When used in coal they should be constructed with heavy steel or cast iron flights secured to extra pipes, and the journals should be hardened and run in chilled bearings fitted with compression grease caps.

The scraper conveyor, consisting of a line of scrapers connected by a single or double strand of chain and running in a steel trough, is the most vehemently condemned, but in spite of this the most widely used of the many forms of conveyors.

The most common objections urged against it are that it is exceedingly wasteful of power, and that it is objectionally noisy. The latter objection was undoubtedly made with considerable justice against the earlier forms—in fact, the validity of this objection is vividly recalled to me by the remark of a manufacturer, who after the test run of the first scraper conveyor installed in his establishment about seven years ago pronounced it a "howling success," and I agreed with him at the time; it was a howling success. The howling, or rather squealing, is due to the vibration caused by sliding a thin blade edgewise along the trough, and is readily and effectually overcome by the dishing of the scraper, the thickening or flanging over of its bearing edges, or its suspension from suitable guides by means of cross bars and the wearing shoes.

The first objection—viz., that the scraper conveyor is wasteful of power—is untrue. What is true is that it takes more power than does

a properly designed bucket conveyor to carry a given quantity of coal a given distance, but this excess of power brings some compensation, and cannot therefore be called a total loss. In bucket conveyors the saving of power is gained only by the addition of very considerable weight and considerable expense. In fact, for machines of similar capacity, a bucket conveyor will weigh four times as much as the running parts of a scraper, and even though the rollers reduce the friction from one-fourth to one-fifth, there is practically no difference in the power required to move these machines empty. It is only when carrying coal that the advantage lies with the bucket conveyor, and then the difference amounts to but 2½ horse power per 100 feet for machines having similar capacities. Perhaps the name of scraper conveyor has been as potent in raising prejudices against it as any other single cause. Scraping is always associated in our minds with noise and commotion; as a matter of fact, the operation of a well constructed scraper line is one of sliding. The trough becomes smooth as glass from use, and the movement of coal is unaccompanied by any commotion. Now, admitting that the scraper consumes more power than the bucket conveyor, what have we to offset or compensate for this loss?

1st. A simple rugged construction that will stand unlimited abuse, and permits of a simple feed and a simple discharge.

2d. A low first cost, not exceeding one-third that of a bucket conveyor of equal capacity, incurring a low interest and sinking fund charge.

3d. Cheap repairs.

After all, that machine is best which shows the greatest net earnings, and the fact that scrapers are exclusively used in the largest coal-handling region in the world by the producers of the coal, with whom the question of breakage of coal and repairs to machinery is of greater importance than to the consumer, is evidence sufficient that its usefulness is not yet at an end. Several improvements of scrapers have been made, most prominent among them the suspended flight conveyor, in which the entire weight of chain and scrapers is carried on guides outside the trough. These guides are covered with grease and reduce the friction considerably, while the fact that the coal only is in contact with the trough insures greater durability.

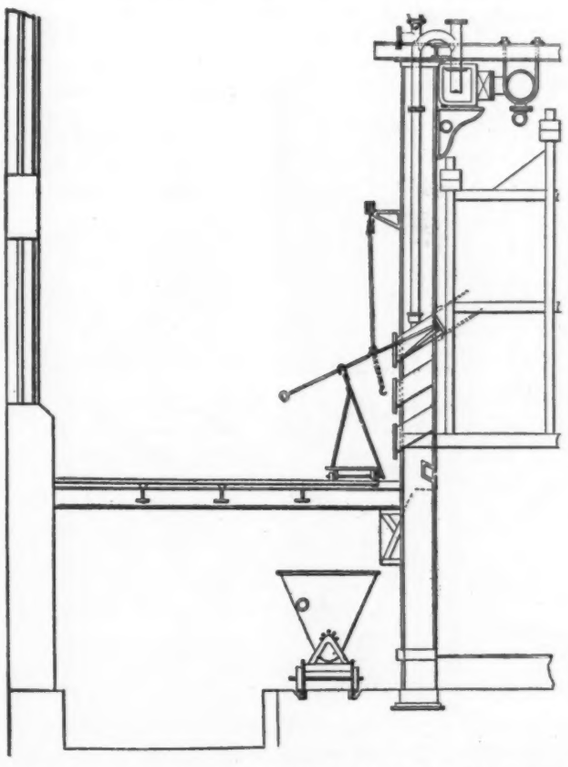
Suspended flight conveyors are perfectly noiseless, are more economical of power and cost less for repairs than the ordinary scraper, and while they cost a little more, they share the other advantages of their prototype.

Flexible belt conveyors have a limited application as coal conveyors and under certain conditions prove highly satisfactory. They do not permit of discharge at intermediate points and have to be run at such speeds, to get capacity, that it results in considerable breakage at the delivery points. The belts are not durable, and charge for repairs is consequently high.

Bucket, pan, and apron conveyors share both the advantages and the disadvantages of flexible belt conveyors, but, owing to the material of which they are constructed, they are more durable as coal-handling machines.

Foster's Patent Stopper for Inclined Retorts.

The *Journal of Gas Lighting* reports that a small but indispensable accessory of inclined retorts is the stopper which prevents the coal traveling into the discharging mouthpiece of the retort; but, although it renders important service, it is perhaps the most abused appendage of the system. It is not an uncommon thing to see stoppers dragged out of the retorts and violently thrown down, so that they soon become misshapen, cracked, and unfit for fulfilling their useful purpose. Most, if not all, of the present stoppers in use are of wrought iron, and riveted together into one piece; and experience shows that, even without the ill usage already referred to, under the intense heat to which they are subjected, they soon become deformed. This Mr. William Foster found was the case at the Brierfield Gas Works of the Nelson Corporation, and it led him to devise a stopper to overcome the faults of the existing types, together with appliances for removing it from and replacing it in the retorts. He has given the whole arrangement a good trial at Brierfield; and there is no doubt that he has succeeded in his aim. By reference to the illustration, a short description will explain the invention. The stopper is of cast iron, and so will better withstand the intense heat to which it is exposed than can the existing wrought iron ones. It is made in two pieces, so that, if an accident happens to one part, it can easily be renewed. The face against which the charge rests is of **D** shape (or it can be made of any other required section), and to the back is hinged a supporting leg, the top of which is so formed that the stopper cannot be forced down by the descending charge. The leg being loosely fitted with a bolt to the **D** portion, the stopper readily adjusts itself to its proper position. The arrangement for removing and replacing the stoppers is an ingenious one. Fixed on to the uprights of the retort bench are brackets for supporting an iron rod, along which travels a small pulley, from the casing of which a hook is suspended. Depending from this is a rod hooked at its lower end and reaching to



the mouthpieces of the top retorts. The rod by which the removal and replacing of the stopper is effected has, as the illustration shows, a **U**-shaped indentation about midway in its length, and this engages with the hook at the bottom of the traveling rod. The end of the removal rod is shaped so as to readily engage with an eye formed in the head of the supporting leg of the stopper just above the joint. On being withdrawn, the stopper can be placed on one side of the mouthpiece; and, the handle end of the removal rod engaging in a hook fixed on one of the top corners of the movable screen, the stopper is left suspended in a line with the mouthpiece, so that there is no chance of it becoming damaged by any careless action on the part of the attendants. For dealing with the second row of retorts, the hanging rod is extended by a chain; while in the case of the bottom retorts, the stopper has simply to be lifted out on to the floor. There is no doubt that this arrangement will have a preserving effect on the stopper and be of material assistance to and help to protect the men, inasmuch as by it they have grea'er control over the discharge of the coke from the retorts. A simple and serviceable adjunct to the inclined retort system such as this seems to be cannot fail to secure wide adoption.

Utilization of Exhaust Steam.

In a paper read by Mr. J. H. Harding, at the last meeting of the Northwestern Electrical Association, on the subject named in the heading, the author said that all who have given thought to the many practical economies possible to be practiced in connection with an electric plant, have figured more or less upon the utilization of the heat going to waste in the exhaust steam. As only a small percentage of the heat contained in the exhaust steam can be used to heat the feed water, the question naturally arises whether the remainder can be utilized. If so, how to the best advantage?

In looking for a means of utilizing the surplus, we find several systems being promoted for heating by exhaust steam. Personally, I have had little knowledge of heating buildings with exhaust steam, at either near or distant points from a central station. My inquiries along that line led me to the conclusion, however, that while some plants were reasonably satisfactory, others were giving much trouble. The

reports indicated that as the load and distance increased, the trouble also increased. Another objectionable feature was the great expense of construction. An economy or saving is of advantage only when it can be utilized without too much outlay of capital.

While investigating we heard of a system in which the heat of the steam was transferred to a volume of water, and that being circulated through a supply and return pipe, delivering the heat to the buildings to be heated. After a careful investigation of the Yaryan system, as it is called, the La Porte (Ind.) Electric Company, of which I am superintendent and manager, concluded to install it at La Porte in 1897.

We find that it is possible to heat buildings within a mile of the station, thus giving a large field to draw custom from, permitting us to go to the residence district, and not to be confined to the business section only. This has been a good thing for us, for while we have our mains in the alley behind seven blocks of business houses, our income is less than 20 per cent. from that source.

We have a line running 1 mile out through the residence part of the city, nine residences being heated located within one block at the end. Again, our station being located at the highest point in the city, made it difficult to return the condensed water from steam mains. With this system it makes no difference; both lines being full of water one balances the other, making it possible to supply heat above or below the station.

One of the strongest features in favor of the system is, that as the water is returned to the station, after it has passed through the buildings to be heated, it suffers no waste of heat, except the amount radiated from the pipe line, and that sold to the customer. That is to say, that if we send out water at 160°, the return would be 130°, so by raising the water 30°, it is up to 160°, and ready to go through the line again. The difference in the amount of heat that would be lost by radiation from the mains, whether they were of an average temperature of 220°, as with steam, or only 160°, as with water, was an important item that we took into consideration.

There are many features of economy connected with the system that will appeal to the central station man when brought to his attention, that would seem too much like an advertisement were I to introduce them here. Suffice it to say, we are satisfied we have a practical way of utilizing all of the exhaust steam at our station.

Discussion.

In answer to a question, Mr. Harding gave the following description of the arrangement for the storage of exhaust steam. We put in a storage tank of about 55,000 gallons. We found in practice, as we have increased the output of the plant, that during all seasons of the year when the thermometer ranges 50° or above, we are able to store up sufficient heat in this storage tank to furnish our mains and maintain proper temperature in the different houses, by simply circulating the water from the tank.

As to the method of connecting up, we have our mains so arranged that we can run the water back through the tank, or by a by-path direct to our pump on the return main, thereby enabling us to draw a sufficient amount of hot water from the tank to bring the temperature up to what we wish on the mains. We regulate the temperature of our water at all times to correspond to the temperature of the weather outdoors, thereby maintaining a uniform temperature in our houses.

Mr. Thayer—While this system presents quite a number of new features, yet it has been in use for several years, and appears to give good satisfaction, but it might be of interest to bring up some features not yet determined in connection with the subject.

The first thing that occurs to me is the liability of the mains to corrode. The New York Steam Heating Company, who were the pioneers in the distribution of steam, put in a system of return mains which returned the water of condensation. They found that these mains were subject to such rapid corrosion that it was cheaper to abandon their use and simply waste the water of condensation, and the question comes up whether the same corrosion will not appear in these pipes, even though the temperature is much less than it would be in the case mentioned.

The cost of pumping here is a feature with which I have had no experience, although I have had considerable experience with steam—but the cost of pumping with a 30-foot head of water with a 30° temperature head, that is, from 160° down to 130°, with 30 pounds of water per horse power per hour on your engine, and 150 to 250 pounds per indicated horse power on your steam pump, when it will take about 3 pounds of steam to maintain your circulation on a horse power of exhaust heat from your engines, and while, of course, the factor during the lightly loaded portion of the day cuts no figure, yet during the maximum, or during the time that you have to waste part of your exhaust steam, or something like that, it would cut some figure.

Another thing is the prospect of whether you are ever going to be able to meter your heat. It is very difficult to prevent a man from wasting his heat. Some men, of course, will be careful, but we know how that works in contract lighting where there is no check whatever, and I know that customers would take advantage of any wide open heat deal in the same way.

The station appliances, of course, I do not suppose have been worked out. But few appliances have been put in, and the whole thing is recent, and we must not criticize the system unduly now, but I should very much like to hear from Mr. Stahl on the details or arrangement of his storage tanks. Some of the time they must deliver their water at a higher temperature than the water in the tank, and they must have a special arrangement for heating the water quickly and sending it right out quickly, and if they depend on their storage tank it may take several hours.

Mr. Stahl—To answer Mr. Thayer's question regarding corrosion. He states that it is found to be impracticable to return condensation from the steam plant back to the station. There are steam plants used now where they put an exhaust pump on the return end and draw the exhaust steam into the radiators and prevent back pressure upon the engine. I would not disparage anybody's else system, but will speak only of the question raised by Mr. Thayer. Water having been converted into steam, drops all its solids and is pure water.

In reference to the control on the inside of the building itself, in individual places, Mr. Stahl stated that they control it by raising and lowering the temperature of the water. He bought a water motor for his own use to furnish the power to compress the air. The valve acted perfectly. He set the thermostat to hold the house at 72, and did not open or close a valve all last winter, nor all summer. He provided a by-pass just back of that thermostatic valve, to take water from the system across the house boiler so as to heat the city water for domestic use. The water motor was running on the same pressure all the year through, and the thermostat shut up the valves so no hot water passed to the radiators in the summer time. At the same time, whenever the temperature dropped below 72 the radiators received the right amount of hot water to keep the house at just the right temperature, and the regulation was perfect.

In answer to a question as to how the radiation required is figured, Mr. Stahl stated: We take the cubic contents of the room. That is one of the things, but glass has a great influence, and exposed wall has a great influence. I have an illustration that I use in talking to individuals. Take a room 15x16x10 feet high, with one window 4x6 and another 3x6, and another 2½x6. The room is an L to a house, and that figures out by the rule 102 feet of radiation. Take the same room and let the side of the house start at 4 feet from the corner, and the other 3 feet, and you have got out some exposed wall. Now, leave out the 2½ x6 window, still leaving the 4x6 in and the 3x6, and that takes 72 feet. So, if you divide it by cubic contents, you would not get the proportionate amount of radiation. We add up the amount of radiation of each room and multiply it by a fixed charge, which charge at La Porte is 12½ cents.

This charge varies at different places, going up as high as 15 cents. They charge 25 cents a square foot for steam radiation in every plant I know of, even where coal is plentiful. With regard to the relation between the radiation surface and the equivalent surface of glass, the rule extended is to take the cubic contents, divide the square feet of exterior surface by 5, 7, 8, 12 or 15, according to its construction, to reduce it to glass. A well constructed frame building lined with paper, well painted so that the siding lies down flat, may be divided by 10—10 feet of exposed wall will lose as much heat as 1 foot of glass. If the building is old and loose, be careful and divide by a small figure, so as to give a relatively large amount of equivalent in glass. Difference in construction determines the divisor. Having reduced it to glass, multiply the total of glass by 75, which will reduce it to its equivalent in cubic contents, and the glass exposed wall is nearly always in excess of the cubic contents. Now, for the first story we multiply that by the fixed decimal .011, the second story by .0081, which is 4 5 as much, for heat rises, and the upper story is more easily heated than the lower. We figure the upper hall for the quantity, and add it to the radiation of the lower hall, putting it all down below, for the upper hall is always warm enough.

Replying to the question as to the average cost of equipping a house, Mr. Stahl said: We can have a profit by charging in territory east of the Mississippi river 10 cents a square foot. The usual price is 40 to 60 cents for hot water apparatus put in by plumbers. In an 8 room house

there are required probably 600 feet of radiation, which, at 30 cents a foot, makes $180. We make a flat charge of $20 for the thermostat. The whole apparatus complete can be installed for $200. Then we also make a flat charge of $25 for each job for service connection—that is, for piping from the main line, boxing, corporation cock, etc., which would be $225 for equipping an 8-room house, a little more than it costs for a good hot air furnace, and not more than it would cost for steam radiation. Now, even though we set 4 square feet of radiator surface, the cost of the piping and the fittings and the labor and the valves, is so much less that the cost of the job is less than it would be for ordinary hot water or steam fitting.

As to the cost of furnishing the heat, say, for an 8-room house, such as has just been described, 600 feet of radiation at 12½ cents is $75. The cost, we have frequently been told, is less than the fuel bill, and besides that you avoid coal ashes, the expense of renewing boilers and furnaces, and have the convenience of securing an even temperature at all times.

The house is always warm. A gentleman at Springfield, Ills., president of a bank there, told me that it cost $125 to keep his home warm; then I said to him at once, you use hard coal, although you have soft coal right here. He said, certainly. I said, why? He said it is cleaner and more convenient. Yes, and I said, you would pay $25 more if there was no furnace about your place, no coal or ashes or dust to settle on the carpets and furniture and no noise and no attention necessary.

The Value of the 10-Inch Slide Rule from the Educational Standpoint.

[By Mr. J. J. Guest, in *Jour.* Worcester Polytechnic Inst.]

[As the 10-inch slide rule is not universally known, it may be well to state that it consists of three parts: (1) the rule itself of dimensions about 10-inch × 1¼ inch × ⅝ inch, (2) a slide fitting it internally, and (3) a cursor. The rule and slide are of wood, usually faced with white opaque celluloid surface upon which are the various scales. The cursor is a small metal frame sliding upon the rule and carrying a line or lines conveniently spaced. Upon the rule are (1) two uniform scales, divided into inches and sixteenths, and metrically, (2) one logarithmic scale 10 inches in length (used in conjunction with the corresponding scale upon the slide for multiplication, division, etc.,) and (3) a pair of contiguous 5-inch logarithmic scales (used in finding square and cube roots.) Upon the front of the slide are logarithmic scales similar to those upon the rule and upon its back are (1) a uniform scale divided into inches and fiftieths (used for finding the logarithmics of numbers), (2) a scale of sixes, and (3) a scale of tangents. Thus the rule comprises inch and metric scales and the means of finding the products, dividends, logarithms, square and cube roots of numbers, and the sines, cosines, tangent, etc., of angles—to a certain degree of approximation.]

Those calculating instruments which depend for multiplication and division upon the manipulation of lengths proportional to the logarithmics of the numbers involved are at present represented commercially by slide rules of lengths 10-inch, 15-inch and 20-inch and by such rules as Thatcher's and Fuller's. The latter, having logarithmic scales of great length, give results of sufficient accuracy for almost every engineering purpose; but they are expensive and office, as opposed to pocket instruments. The 15-inch and 20-inch are larger editions of the 10-inch rule, the accuracy being proportionally increased. The primary recommendation of the small (10-inch) slide rule is the rapidity with which the customary engineering calculations can be made with it, and as so much of a student's time is spent in calculations requiring no very great accuracy, the result is a great saving of his time. The question as to the accuracy of the instrument—meaning thereby the greatest error, other than a mistake, which can occur with reasonable care in manipulation, resolves itself into two parts; first, what are the errors of graduation of the logarithmic scales, and secondly, what errors are due to the operations.

To determine the former the 10-inch logarithmic scales of a number of rules were calibrated by the aid of a dividing machine. The lengths of the rules were slightly different, and in order to lessen the labor of calculating the errors, the correct positions of some of the graduations of a logarithmic scale of a length of 250 mm (the dividing machine worked on the metric system) were calculated and an allowance made for the difference between 250 mm. and the actual length of the scale.

Let a be the standard scale length (250 mm) and x the length of that scale to the graduation n, then $x = a \log n$. The effect of any error in x upon n is therefore $\delta n = a \frac{\delta n}{n}$ or $\frac{\delta n}{n} = \frac{\delta n}{a}$, so that the proportional effect of every error (which will be called "the error") is independent of the part of the scale in which it occurs and is equal to that error divided by the length of the scale.

Let ξ be the difference between the value of x and the measurement of the corresponding graduation upon a scale whose length is $a + \alpha$. Then the total error of graduation is

$$\xi - \frac{x}{a}n, \text{ and of the proportional error } \left[\frac{\delta n}{n}\right] \text{ produced is } \frac{\xi}{a} - \frac{x}{a^2}x.$$

Since $\frac{x}{a^2}$ or $\frac{\log n}{a}$ is independent of the particular rule under calibration, it can be calculated once for all, and thus the determination of the errors, involving the small quantitive ξ & x can be made by the use of the rule itself.

In the table appended, the first four columns are calculated for the 250 mm length; the next five columns give the calculation for one of the scales, the one met with which showed the greatest errors being selected for this purpose. The final column gives the mean error of the scales at the various graduations. It will be noticed that the errors of the ends of the scales are taken as zero (and all the intermediate errors were in one direction in all cases.) This plan was adopted as no instrument in which the lengths of the logarithmic scales on the slide and rule are visibly different should be accepted for use. [Strictly the length of the scale, for slide and rule combined, giving equal positive and negative signs to the largest errors should be adopted, but the smallness of the errors involved rendered this refinement unnecessary.] From the table it will be seen that the greatest error of graduation met with was 0.00018, corresponding to about $\frac{1}{1000}$ inch. So that it is at once evident that errors due to manipulation will far exceed those due to imperfections in the graduation of the rule. The errors due to manipulation consist of errors of estimation of the fractional parts of the spaces of the scale and errors in setting the slide and cursor. Of these the former error is about + 0.05 of a space for the larger spaces, or about 1 in 800 or 0.0012; and the second error depends largely upon the speed at which the rule is worked; with great care it can be reduced to a very small quantity.

In any operation, however, the errors accumulate. Thus if x, y and z be the errors of graduation, estimation and setting respectively, the possible error which can be introduced in an operation such as $\frac{a \times b}{c}$ done at a single setting is $3x + 3y + 3z$ if a, b and c are all numbers requiring estimation of fractions of spaces. Taking $x = 0.0002$, $y = 0.0012$ and $z = 0.0005$, the error can reach the value 0.005, or rather more than one-half per cent.

Possible errors for other operations are easily calculated, and each operator can determine values of y and z suitable to himself and the care necessary for a desired accuracy. The error thus arrived at is the possible error, an amount very unlikely to be approached.

Thus for the reductor of experiments which involve measurements having errors of 1 per cent. for the determination of the effect of errors in the various measurements upon the final result, the accuracy of the slide rule is amply sufficient; also it may well be used in mechanical design and in working out problems.

The fact that few significant figures can be determined by it possesses the advantage, from the teacher's standpoint, that the fewer the figures the clearer the grasp that is obtained of their significance.

When an accurate calculation is required the slide rule may profitably be used to check each step and thus avoid the chance of labor being wasted by an early mistake.

The question of speed being involved with the question of accuracy, it is difficult to determine the speed of working, as direct experiments upon the rule by comparing results obtained by it at a speed, with those obtained by accurate calculation, are valueless unless made in enormous quantities and by each observer separately; but no user of the slide rule has any doubt about its value as a time saver.

Mention may be made of the advantages which accrue from the development of the accurate use of eyes and fingers, from the substitution of an almost mechanical operation for an intellectual one (a point with the hard-worked student), from the practical certainty that all decimal points are located truly and from the fact that mistakes are infrequent and that a repetition of the calculation occupies very little time.

For the above reasons the attention of teachers of engineering may profitably be turned upon this small instrument.

(See table on following page.)

				Example of Set of Observations—(that of having the Highest Errors).					
n.	logn (from tables).	x = 250 mm. logn.	$\frac{x}{a^2} = \frac{\log n}{a}$	Measurement, *i.e.*, observed value of x.	ξ = x — measurement.	$\frac{\xi}{a}$	$\frac{x}{a^2} \times a$	Error. $= \frac{\xi}{a} - \frac{x}{a^2} \cdot a$	Average Error.
1.0	0	0	0	0	0	0	0	0	0
1.5	0.1760913	44.0228	0.0007	44.016	0.0068	0.000027	0.0000038	0.000023	0.000018
2.0	0.3010300	75.2575	0.0012	75.251	0.0065	0.000026	0.0000066	0.000020	0.000030
2.5	0.3979400	99.4850	0.0016	99.470	0.015	0.000060	0.0000088	0.000051	0.00010
3.0	0.4771213	119.2803	0.0019	119.262	0.0183	0.000072	0.0000105	0.000062	0.00008
4.0	0.6020600	150.5150	0.0024	150.485	0.0300	0.00012	0.0000132	0.00011	0.00015
5.0	0.6989700	174.7425	0.0028	174.6945	0.0480	0.00019	0.0000155	0.00017	0.00015
6.0	0.7781513	194.5378	0.0031	194.4955	0.0423	0.00017	0.000017	0.00016	0.00014
7.0	0.8450980	211.2745	0.0034	211.238	0.0365	0.00014	0.000018	0.00012	0.00010
8.5	0.9294189	232.3547	0.0037	232.3035	0.0512	0.00020	0.000020	0.00018	0.00013
10.0	1.0000000	250.0000	0.0040	249.9945	0.0055	0.000022	0.000022	0	0
		= a			= x				

Boiler Flue Drilling Machine.

Engineering says that the machine shown in the accompanying illustrations has been specially designed and provisionally protected by Messrs. Victor Coates & Co., Limited, of Belfast, Ireland, for drilling the flue joints of Lancashire and Cornish boilers in a vertical position, so as to insure a perfectly true hole through the three thicknesses of plate, namely, the two flanges and the caulking ring, which, when together, form what is commonly known as the Adamson's joint. The chief feature of this machine is that when two flue rings and the caulking ring are fixed together for drilling, instead of being held at one end by a universal chuck, as is customary with the ordinary machine, they are caught in the center by the turned flanges, the two outer ends being allowed to revolve free. As this is the joint on which the drills are to operate, and this joint is revolved by the pitch gear attached to the universal chuck plate, it can be easily seen that the rivet holes must be naturally truer than by any other arrangement.

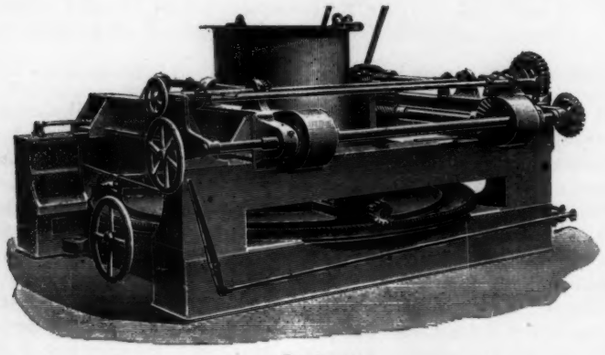
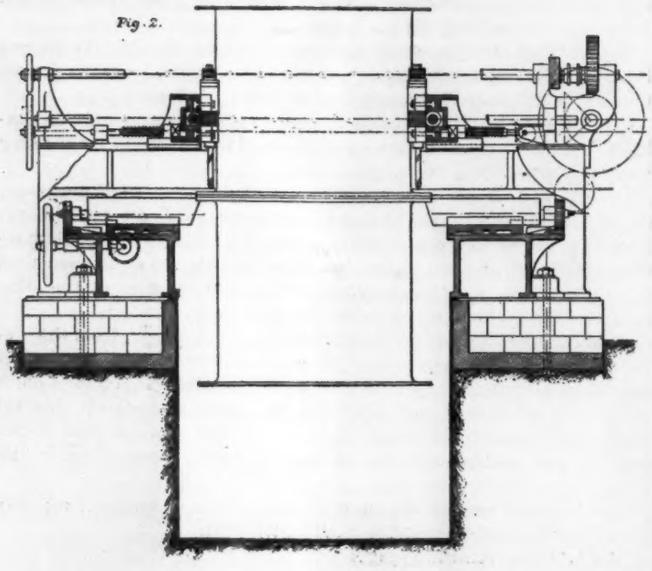


Fig. 1.

Fig. 2.



With a view of carrying out this work with the greatest despatch, four drills are arranged to operate simultaneously. These are carried by two beams which can be traveled in and out at will, towards and from the center of the machine, for drilling the various diameters of flues, and for placing the rings in the machine, and for removing them. The drills are especially designed to run at a high speed, being fitted with water service, and are so compact that the shortest flue rings can be drilled; they are adjustable by hand for the various pitches. It is worthy of note that the floor space occupied is only 9 feet square, the total height above the ground being only 4 feet.

We are informed that, owing to automatic arrangements which are adopted wherever possible, one joint can be drilled per hour. The numbers of these joints in a Lancashire boiler 30 feet by 8 feet for 120 pounds are, as a rule, about 18; so that the capabilities of this compact little machine can easily be seen.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Mr. E. D. Johnston, President of the P. H. & F. M. Roots Company, has received the contract for the construction of an irrigation pumping plant at New Orleans, La., the cost of which will amount to nearly $100,000. The contract calls for the placing of the Company's celebrated rotary positive pressure pumps, which it has been building and putting on the market for 40 years.

Mr. W. P. Taylor, Treasurer of the Wilmington (Del.) Coal Gas Company, has notified the shareholders that they are entitled on demand to a dividend of $3 per share. This is the 93d dividend declared by the Company.

Secretary Runner, of the Freeport (Ills.) Light and Fuel Company, is busily engaged in getting ready for the spring and summer campaign for the placing of gas ranges. Amongst the literature which he has thus far prepared to further the end in view may be found two very effective documents, one of which is a tabulated, alphabetical list carrying about 400 names and addresses of prominent citizenesses of Freeport who use gas ranges in their kitchens. The other document recites the matter contained in the first nine responses to letters sent out last year by the Company asking those who used gas for cooking their opinion about it.

MR. THEODORE M. KEPPELMAN, Manager of the gas stove department of the Consumers Gas Company, of Reading, Pa., has thought out another novel scheme for booming gas ranges in that city, as the following circular, which has been liberally distributed throughout Reading, will show :

CONSUMERS GAS COMPANY, GAS STOVE DEPARTMENT, }
READING, PA., Feb. 1, 1899. }

To the Ladies of Reading—Greeting : We are going to award some lady a beautiful gas range, free of all cost. You may be the fortunate one. There are now over 1,500 gas stoves in this city, and their superiority over other stoves is thoroughly established. To still further demonstrate their excellence, we have fitted up a model kitchen at our stove department, 16 North Fifth street, and we invite you to call there any day or evening. A competent cook will give daily demonstrations in cooking, and practical lessons in the use and care of gas stoves that cannot fail to be of value.

Every lady who calls will be presented with a coupon, and the lady whose name appears on the most coupons, on March 31, 1899, will be presented with a handsome gas range. All you need do is to fill out the coupon, either with your own name or the name of any lady friend whom you would like to see get the range.

We cordially invite you to call. Bring your friends with you and show them how much easier, pleasanter, cleaner and cheaper it is to cook and bake when one uses a gas stove.

The contest is now open and will continue only until March 31, 1899, at which time all coupons must be sent in, and the award will be made as soon thereafter as possible. Very respectfully yours,

THE CONSUMERS GAS COMPANY.

PROF. PIERCE B. WILSON, inspector of gas and illuminating oils, for the city of Baltimore, reports that the lighting value of the gas distributed by the Consolidated Gas Company is on the average fully 25 per cent. in excess of the statutory requirement. The value called for by the statute is 20 candles.

ACCORDING to the report made to the City Controller, by General Manager Walbridge, of the Detroit City Gas Company, the Company manufactured and sold, during the last half of 1898, on illuminating account, a quantity of gas equal to 133,132,800 cubic feet.

MR. R. B. TABER has resigned the Presidency of the Lexington (Mass.) Gas Company. His successor has not yet been chosen.

MR. SAMUEL ROLFE, a member of the Board of Trustees, and former Treasurer of the Portland (Me.) Gas Light Company, died at his home in that city the morning of January 30. Deceased, who was in his 85th year, was born in Portland, and there his career was continued and completed. He is survived by three sons.

MR. CROSBY, Deputy City Auditor of Cleveland, Ohio, reports that the total amount collected for the city on license account during 1898 was $85,560.63. Of this sum the Gas Companies paid no less than $61,845.53.

MR. TRAUTMAN, of the lower division of the Illinois Legislature, is responsible for the introduction therein of a measure which proposes to regulate the supply of gas and electricity for light, heat and power, and to provide for the municipal control of the same. The bill provides for the appointment, for 2 years, of a gas and electric commissioner, in villages by the Presidents of the village boards, and in cities by the Mayors ; 1 commissioner for each village ; 1 for each city having a population less than 100,000 ; and 3 commissioners for each city having a population of 100,000 or more. The duty of the commissioners is to examine the books and records of all gas or electric companies and to report all violations of laws applying to the trades named. The measure declares that in cities of the first class the gas rate shall not exceed 75 cents per 1,000 cubic feet for the first 1,000 cubic feet used in the month, the rate for excess of consumption in the same month to be 60 cents per 1,000. It is also stipulated that the rates for electric lighting and power supply are to be regulated by the Trustees of villages and by the Councils of cities. This "bill" may justly be termed a beauty ; its complexion and figures are so striking.

THE following (from the Philadelphia *Times* of the 2d inst.) was forwarded by a correspondent : "The United Gas Improvement Company has filed with the Philadelphia City Controller a statement of improvements and betterments made by it during the year 1898 as provided in the lease of the gas plant to the Company by the city. The amount expended, as shown by the statement, is $3,112,829.07. This statement covers 2,131 pages. Since the United Gas Improvement Company began the operation of the Philadelphia gas plant it has been engaged in making the changes and improvements referred to in the discussion of the question and decided upon by its engineers as necessary or important. This work may be generally divided between improvement and extension of the manufacturing and storage plant and improvement and extension of the distributing system. At the Point Breeze works there has been erected and put into operation an entirely new water gas plant of 20,000,000 cubic feet maximum capacity. This plant consists, generally, of a generator house 96 feet by 183 feet, containing 12 sets of improved Lowe, double-superheater water gas apparatus ; an engine and boiler house, 52 feet by 212 feet, containing 1,500-horse power water tube boilers and 350-horse power Corliss engines, with the necessary pumps, blowers, etc. ; 1 condenser house, containing 20 multitubular condensers, each of 1,000,000 cubic feet capacity ; 1 relief holder, of 1,500,000 cubic feet capacity ; an exhauster, valve and meter house, 66 feet by 219 feet, containing necessary engines, exhausters, meters and system of valves for controlling the flow of gas ; 1 purifying house, 82 feet by 176 feet, containing 8 purifiers, each 30 feet by 36 feet, by 5 feet deep. All of the above buildings are of brick and stone. There is also in process of construction and nearly completed 1 coal gas retort house, 72 feet by 272 feet, containing 324 retorts of a total maximum capacity of something over 3,000,000 cubic feet. In addition to these principal items other extensive improvements have been made, including boilers and engines for various purposes ; a complete system of water mains for fire and other purposes ; a coal storage shed and two systems of coal conveying apparatus ; pavements, sewers, governors, valves, 42-inch connections between the various parts of the plants, etc. At the 25th Ward works the water gas plant has been increased by the addition of 8 sets of improved Lowe, double superheater apparatus, and the erection of a purifying house, holding 4 purifiers, each 30 feet by 36 feet, by 5 feet deep ; a condenser house, with 12 scrubbers and 12 condensers, with a total capacity of 12,000,000 cubic feet ; and the remodeling of other parts of the apparatus, including one holder at 2,000,000 cubic feet capacity. At the Ninth and Diamond street station a stable with stall room for about 100 horses has been erected, and will be occupied within a few days. At the Market street street station a new holder, up to retaining 2,000,000 cubic feet, has been erected. The two testing stations to be equipped with photometers and all necessary apparatus for the use of the inspector to be appointed by the city, under the terms of the lease, are in process of erection. One is located at the corner of 17th street and Passyunk avenue, the other near the corner of Ann and Richmond streets. In the streets there have been laid approximately 9 miles of 30 inch main, connecting the Point Breeze works with the Market street holders, and the 25th Ward works with the 9th and Diamond street holders, and the latter with the 30-inch main previously laid on 16th street. There have been laid approximately 110 miles of mains, including pumping and distributing mains to Chestnut Hill and Manayunk and distributing mains of from 6 to 20 inches diameter laid throughout the city to improve the distribution and supply the many buildings erected during the year, and to keep ahead of the paving operations undertaken by the city. The results of the various changes, as far as they affect the service to the public, have been the increasing of the illuminating power of the gas to an average of something over 22 candles, and an improvement in the distribution to such an extent that whereas some parts of the city have in the past had insufficient pressures, all are now supplied with gas at pressures that are satisfactory for all purposes. Another result of the improvements and extensions is that the manufacture of gas at the Market street works has ceased, and the odors and smoke emanating from that works, and which for many years have been more or less objectionable to the inhabitants of the neighborhood, have ceased. This plot of land comes into the possession of the city in a few days. Mr. Seeds, Chairman of the Finance Committee of Councils, has said that the city would probably realize from the sale of this property in the neighborhood of $2,000,000. The United Gas Improvement Company, in obtaining new consumers, and improving the service of consumers who were troubled over lack of pressure, has laid about 26,800 services and set about 82,000 meters during the year. In carrying out the provisions of the lease there have been set about 290 new street lamps. In the laying of services and making betterments to mains and services, there were 140,000 openings made in the streets of the city, in addition to the 119 miles required by the laying of new mains."

A COMMITTEE from the City Council of Aberdeen, South Dakota, has been named to investigate and report upon the desirability of taking

over the plant of the Aberdeen Gas and Electric Light Company for operation on municipal account.

"F. R.," writing from Philadelphia under date of the 6th inst., says: "Although rather late in the day or the time (considering that the meeting was held over 3 weeks ago), I herewith inclose the names of the officers selected to manage the affairs of the Delaware County Gas Company, Chester, Pa., for the ensuing year: Directors, W. S. McManus, Richard Wetherill, George B. Lindsay, O B Dickinson and Richmond L. Jones; President, W. S. McManus; Vice-President, Richard Wetherill; Secretary and Treasurer, L. A. Tucker."

A CORRESPONDENT in Middletown, O., writing under date of the 6th inst., says: "I noticed in your issue of February 6th that you gave the names of Directors of the Middletown Gas and Electric Light Company only in part. The Directors are: W. L. Dechant, G. N. Clapp, C. E. Denny, John Auer, W. O. Barnitz, J. J. Gallaher and T. E. Reed. The officers are as follows: President, W. L. Dechant; Vice President, C. E. Denny; Secretary, Treasurer and General Manager, G. N. Clapp. Under the present management the plant has been greatly improved. It is now backed by home capital, and is in a healthy condition to handle the business in future."

MR. J. A. SAWTELLE is acting as President of the Charlestown (Mass.) Gas and Electric Company during President Hunnewell's trip abroad.

MR. MACKAY, of Boston, has introduced in the lower branch of the Massachusetts Legislature the following resolution looking to an investigation of the gas "situation" in Boston:

Ordered. That a joint special committee to consist of 7 members of the House and such as the Senate may join, be appointed to report the present cost of the manufacture of gas in Boston, the cost of distribution thereof, the amount of profit made thereon, the amount of the capital securities and obligations, whether legal or illegal, now outstanding or offered for sale, based upon the gas business of Boston, and the amount of profits, dividends and interest paid thereon, and what legislation is needed, if any, to enable the Board of Gas and Electric Light Commissioners to fix the price at which gas shall be sold to the consumer, and by one company to another, and to limit the profits which shall be made, and the interest, profits or dividends which may be paid upon any and all securities or obligations based upon the gas business of Boston, and what legislation is needed, if any, to prevent, restrict and limit the securities or obligations which may be issued or sold based upon such gas business, and such other legislation, if any, as they may deem advisable in the premises; that said committee have full authority and power to compel the attendance of witnesses, and the production of books and papers, and to employ a stenographer.

RUMOR is busy in the direction of asserting that the management of the Lexington (Ky.) Gas Company is to be materially changed. In any event, the election of a new Board of Directors has taken place, the gentlemen chosen being J. F. Morton, E. L. Hutchinson, Louis des Cognets, T. D. Mitchell, A. B. Lancaster and Avery S. Winston. The belief is that this spring the works will be rebuilt and the main system largely extended, so that the Company will be in position to better minister to the gaseous needs of the city. The fact is that the executive management of the Lexington Company has been decidedly on the slow side for the past ten years or so.

MR. ALLAN C. MCGARTH, who has been Superintendent of the Chambersburg (Pa.) Gas Company since the completion of its works in 1856, has been retired on account of ill health. The Company meanwhile will pay him full salary. His successor is Mr. Henry R. Blair.

AT a special meeting of the Directors of the Portland (Me.) Gas Light Company, convened to make a suitable memorial to the late Mr. Samuel Rolfe, the following resolution was adopted:

"*Resolved* That the death of Mr. Samuel Rolfe has removed from us a valued friend and associate of many years. From 1876 to 1882 he was a Director in this Company and Chairman of the Committee on Accounts, and from that time until last May he was our Treasurer. Throughout these 22 years he has given constant attention to the financial affairs of the Company, and much of its success has been owing to the judicious investment and careful management of its funds under his able advice and direction. All moneys not needed for immediate use were kept at interest without loss, and his accounts were invariably found correct.

"As associate he won our regard by the uniform kindliness of his disposition and our respect by his ability and undeviating integrity, and we feel that this brief tribute to his memory should be entered upon our records."

THE generating plant of the Ogdensburg (N. Y.) Gas Company is to be rebuilt, the coal gas system to be retained. Messrs. J. H. Gautier & Co., of Jersey City, N. J., are to furnish the material and construct the benches. Messrs. Deily & Fowler, of Philadelphia, have also been awarded a contract for a holder to rest in a steel tank. We have not been advised as to the dimensions of the latter.

THE properties of the Macon (Ga.) Gas Light and Water Company have been returned to the proprietors, through an order from the Court to Receiver Tinsley. The executive management named is appended: Directors, H. T. Powell, Walter Wood, Arthur E. Boardman, Stuart Wood, W. G. Solomon, William H. Felton, Jr., and Spencer A. Jennings; President, H. T. Powell; Treasurer, Stuart Wood; Superintendent, E. J. Elles.

THE Passaic (N. J.) Gas and Light Company is extending its mains through the streets of the township of Franklin.

THE contract for the lighting of the City Hall, Portland, Oregon, has been awarded to the Portland Gas Company for a period of two years. The rate agreed on is $1 50 per 1,000 cubic feet. The structure has heretofore been lighted by electricity.

THE reduced gas rate in Oroville, Cal., has worked greatly to the advantage of the output from the gas section of the Oroville Gas and Electric Light Company's plants.

THE United Gas Improvement Company, preparing for the future extension of its business in Paterson, N. J., has acquired the site and buildings formerly occupied by the Riverside Bridge Company. The plot, which is located at Putnam and East Fifth streets, has the dimension of 200 feet by 408 feet.

THE changes and betterments contemplated in connection with the plant of the Spokane Falls (Wash.) Gas Light Company really mean that the works will be of the 10-inch order. The present rating is 6-inch.

THE proprietors of the Hartford (Conn.) City Gas Light Company have petitioned the Legislature for the right to increase its capital stock to a sum not to exceed $1,000,000.

PAPERS incorporating the Rochester (N. Y.) Gas Engine Company have been filed. The Company is capitalized in $25,000, and its Directors are J. J. Leary, F. F. Wells and Chas. M. Shaw, all of Rochester.

MR. JAMES H. HOOD, for many years connected with the Roxbury (Mass.) Gas Light Company, died at his home in Roxbury the morning of January 30th.

THE Trenton (N. J.) *Gazette* is responsible for the statement that the executive management of the "combined" gas interests of Trenton is as follows: President, H. C. Moore; Vice-President, Thomas Barr; Treasurer and Secretary, A. R. Kuser; General Manager, Richard Stockton; Engineer, F. D. Moses. The *Gazette* further said that "after the meeting an elaborate dinner was served at the Trenton House." It is rather a pity that the "readjustment" of the gas supply of Trenton was not accomplished under conditions other than those which preceded the onslaught of the campaigners who are now in control.

The Market for Gas Securities.

The market for city gas shares showed marked advance during the week, with Consolidated taking the lead. It sold up to 211¼ as the maximum, and down to 204¼. To-day (Friday) the opening was made at 208 to 208¼, and there was good demand for the shares. Another feature was the upward movement in Standards, the common being 136 bid, with the preferred 150 bid. New Amsterdam common moved up sharply, sales having been made at 39¼. Mutual is 312 to 315. The last of the Consolidated Company's treasury stock has been marketed, and the limit of its initial capitalization ($39,078,000) is reached. The authorities in control of the situation in New York are almost willing to admit that the end is in sight.

Brooklyn Union sold above 151 during the week, but a reaction followed, the rate to-day being 148 to 148¼. The assertion is freely made that the time is not far off when Brooklyn Union will be on an 8 per cent. basis. There is no particular change in the out-of-town share values, save in Peoples, of Chicago, and in Consumers, of Jersey City. The first named is lower, the latter is radically higher. Washington (D. C.) gas is 260 bid.

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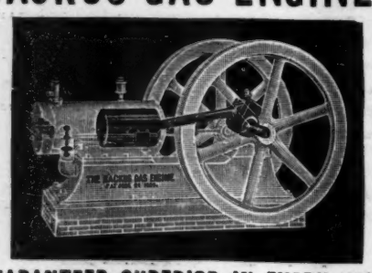

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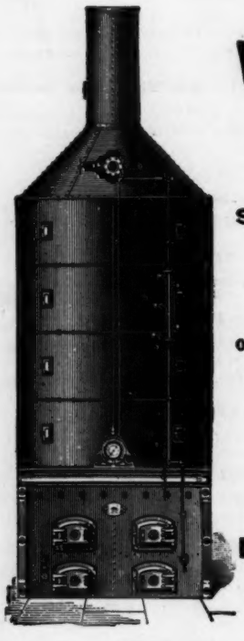

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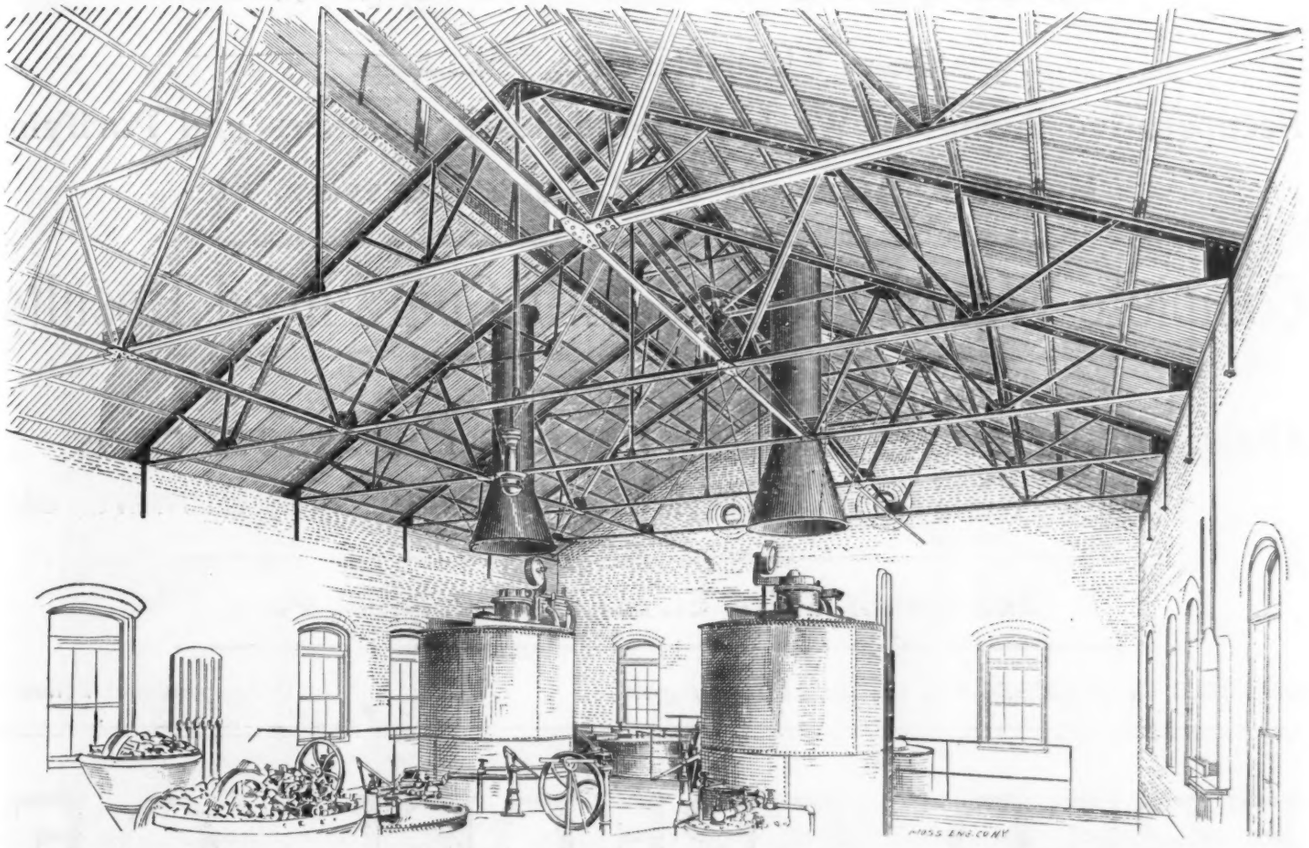

The above illustration is taken direct from a photograph, and shows the construction of an Iron Truss Roof designed and built by us for the Providence Gas Company, at Providence, R. I. The building is 40 feet in width by 100 feet in length, the roof being entirely of iron—that is, iron trusses, iron purlins, and covered with corrugated iron, thus making it absolutely fireproof, no woodwork being ussd about the construction. The ridge is covered with one of our improved ventilators, extending the full length, with side shutters opening and closing from the floor. This roof was built by us several years ago, and we have lately received from the same Company a contract for several other large buildings in the extensions which they are about to make.

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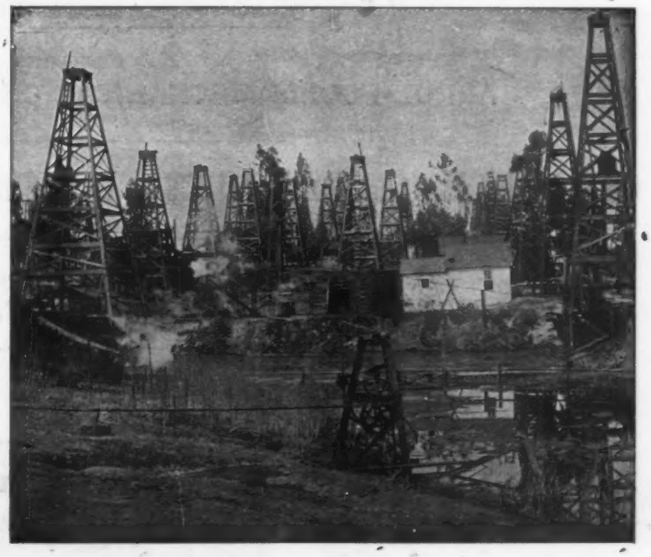

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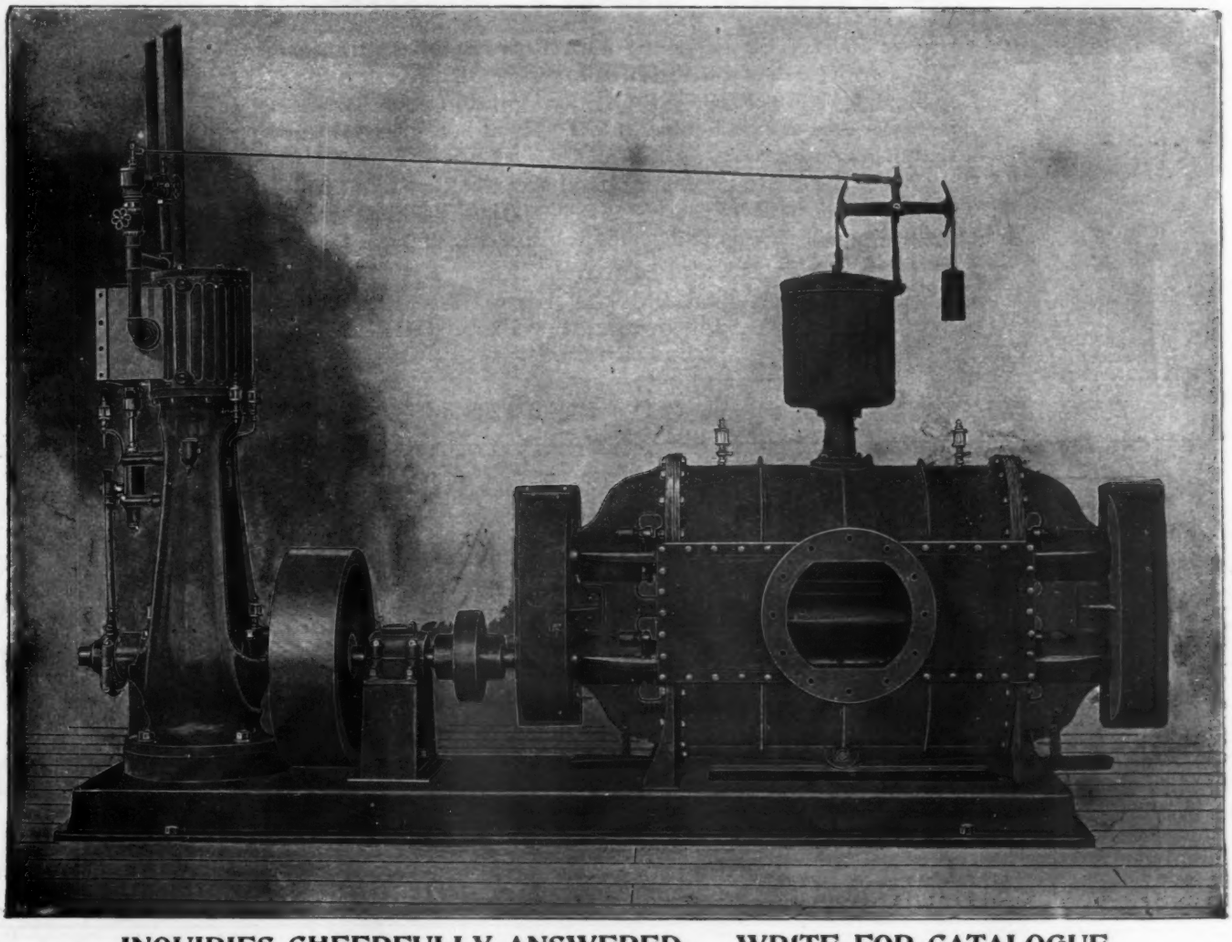

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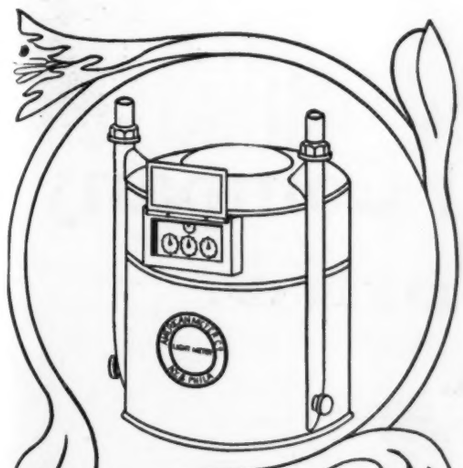

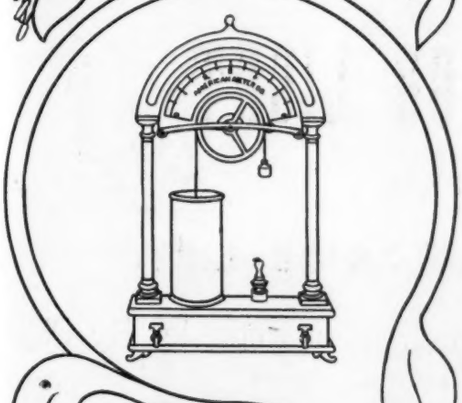

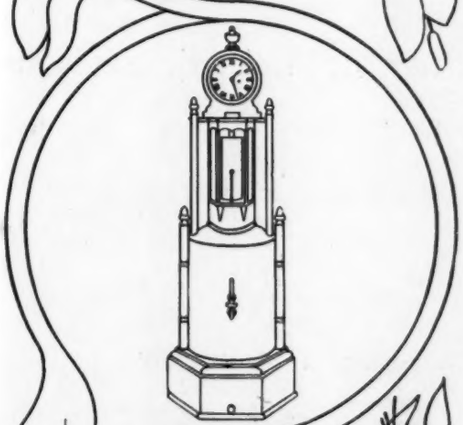

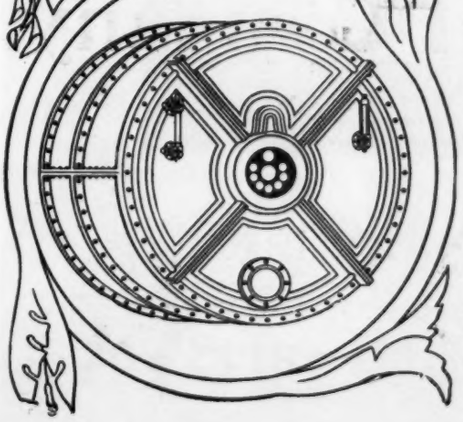

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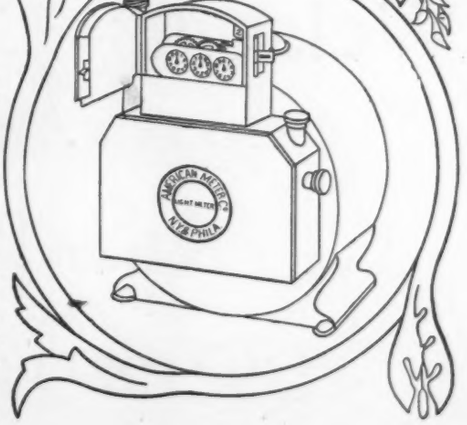
FEBRUARY, 1899.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Wed.	1	5.50 PM	12.20 AM	5.05	6.15
Thu.	2	5.50	1.30	5.05	6.15
Fri.	3	5.50 LQ	2.40	5.05	6.15
Sat.	4	5.50	3.40	5.05	6.15
Sun.	5	6.00	4.50	5.10	6.10
Mon.	6	6.00	6.00	5.10	6.10
Tue.	7	6.00	6.00	5.10	6.10
Wed	8	6.00	6.00	5.10	6.10
Thu.	9	6.00 NM	6.00	5.10	6.10
Fri.	10	6.00	6.00	5.10	6.10
Sat.	11	6.00	6.00	5.10	6.10
Sun.	12	6.00	5.50	5.20	5.55
Mon.	13	6.00	5.50	5.20	5.55
Tue.	14	10.00	5.50	5.20	5.55
Wed.	15	11.10	5.50	5.20	5 55
Thu.	16	12.10 AM FQ	5.50	5.20	5.55
Fri.	17	1.10	5.50	5.20	5.55
Sat.	18	2.00	5.50	5.20	5.55
Sun.	19	2.40	5.50	5.30	5.55
Mon.	20	3.20	5.50	5.30	5.55
Tue.	21	4.00	5.50	5.30	5.55
Wed.	22	4.30	5.50	5.30	5.55
Thu.	23	4.50	5.50	5.30	5.55
Fri.	24	No L.	No L.	5.30	5.55
Sat.	25	No L. FM	No L.	5.30	5.55
Sun.	26	No L.	No L.	5.30	5.45
Mon.	27	6.20 PM	9.10 PM	5.30	5.45
Tue.	28	6.20	10.20	5.30	5.45

TOTAL HOURS LIGHTING DURING 1899.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	215.40	January	423.20
February	184.40	February	355.25
March	187.40	March	355.35
April	166.50	April	298.50
May	158.00	May	264.50
June	140.50	June	234.25
July	150.30	July	243.45
August	168.30	August	280.25
September	179.50	September	321.15
October	213.20	October	374.30
November	217.00	November	401.40
December	238.10	December	433.45
Total, yr.	2221.00	Total, yr.	3987.45



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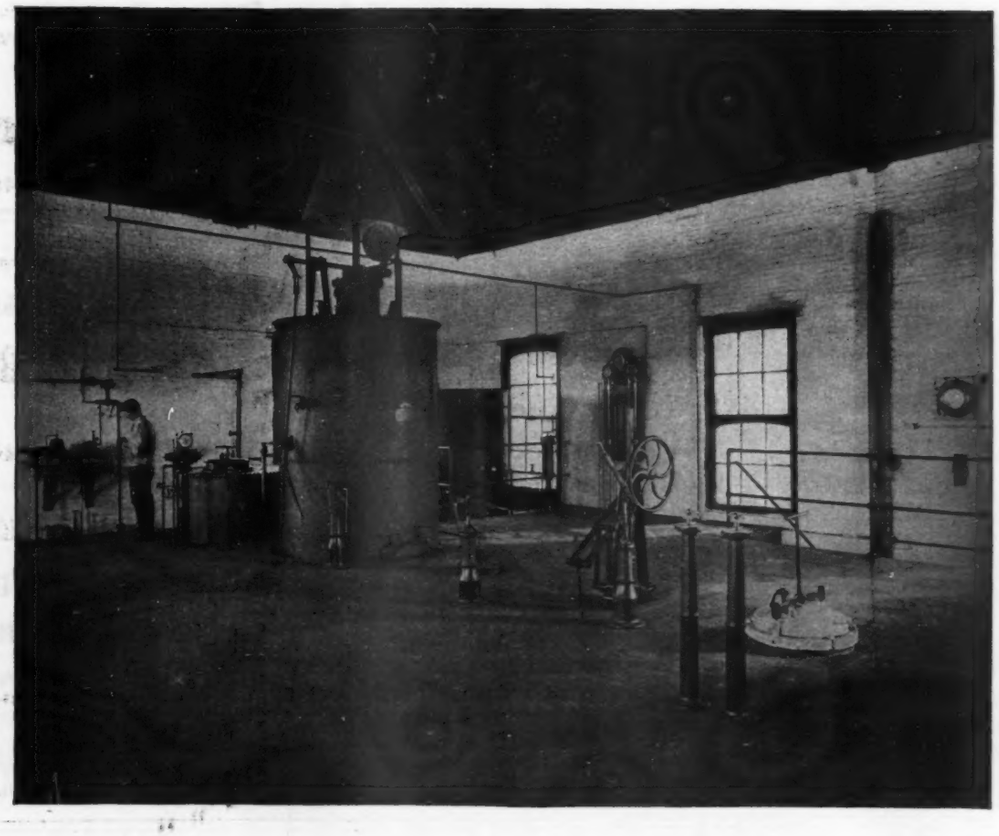

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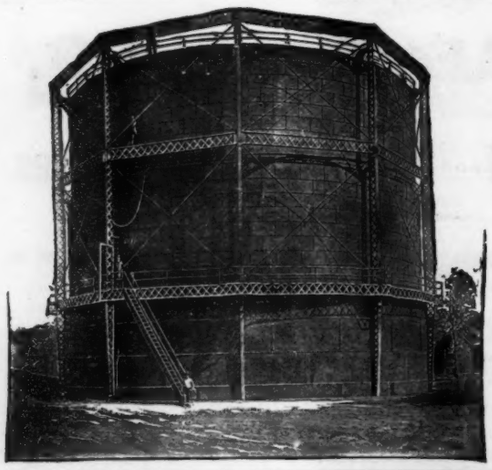

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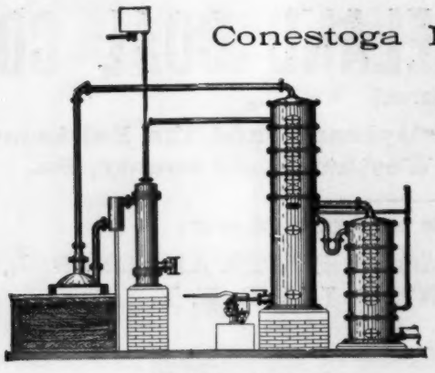

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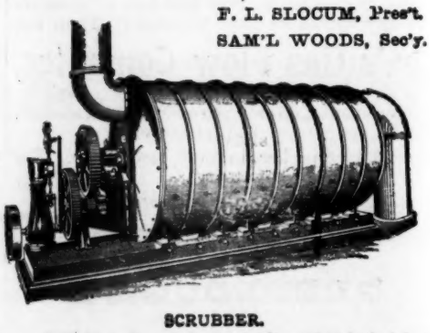

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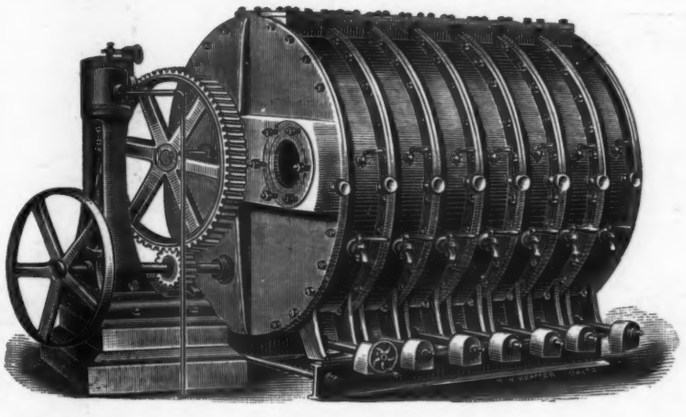

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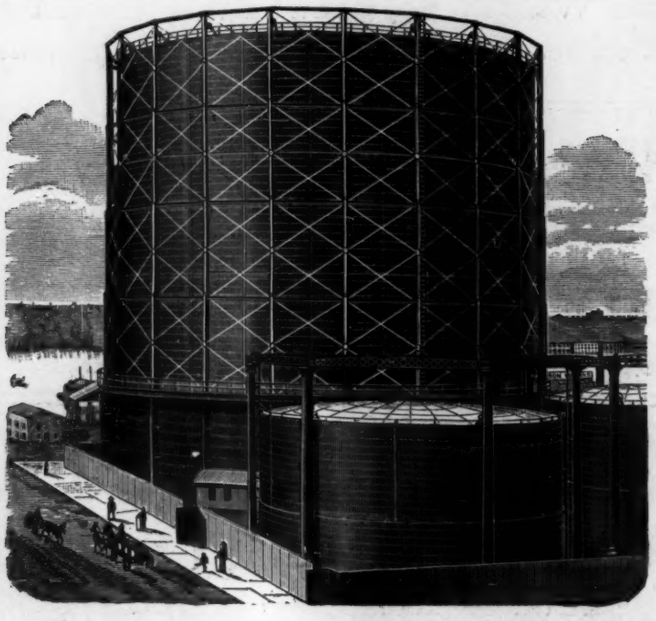

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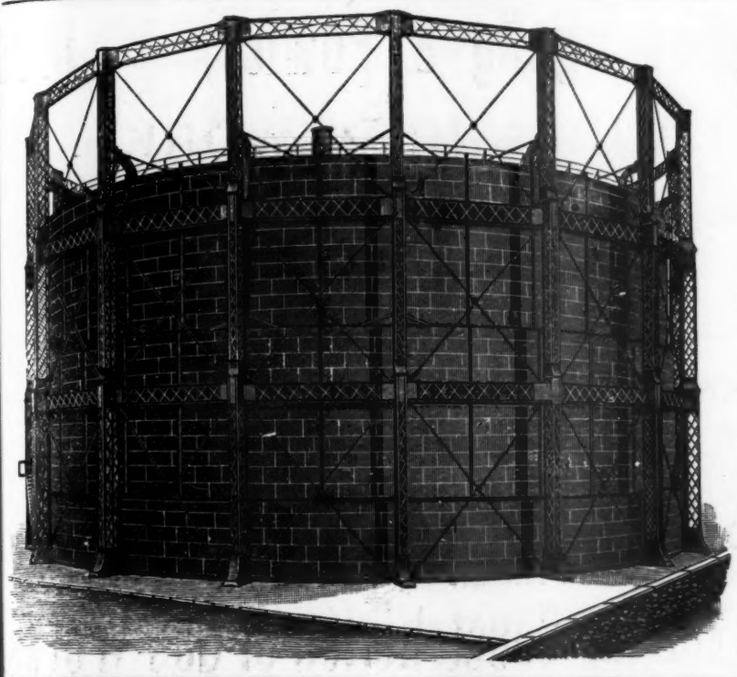

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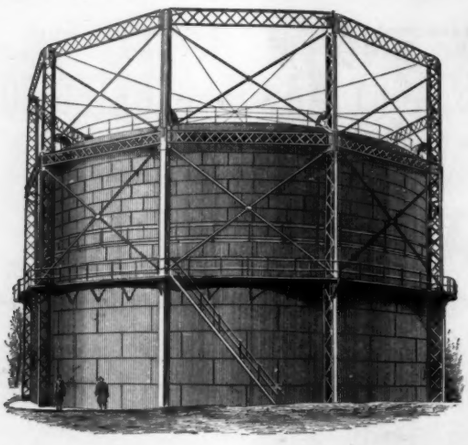

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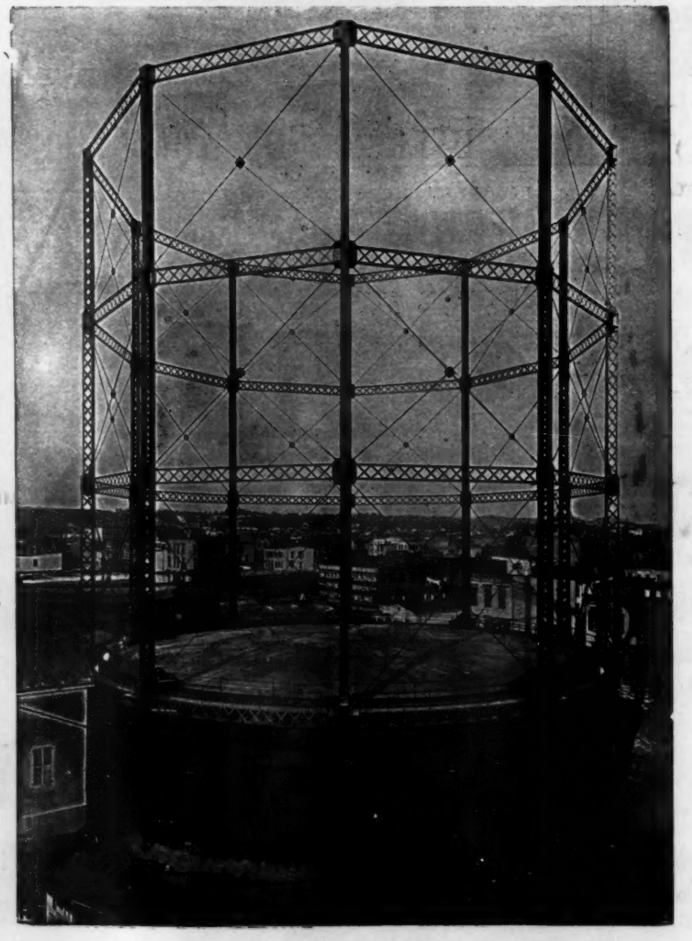

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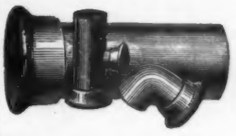
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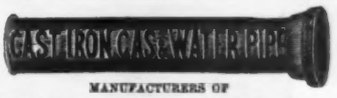

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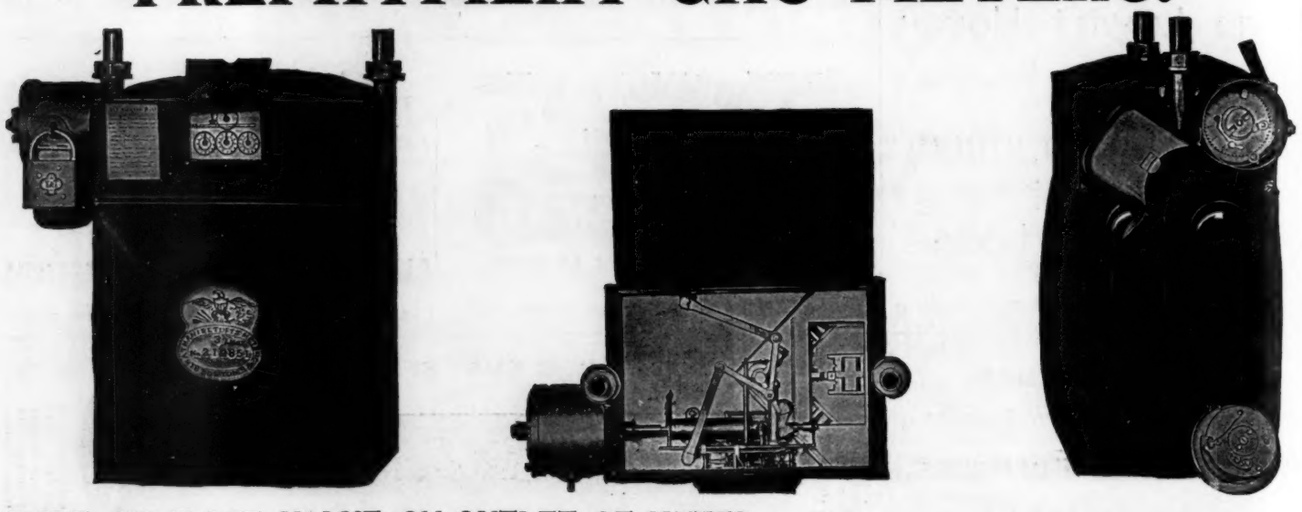

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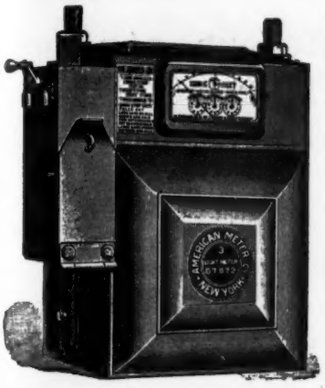

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